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ART. XVI.—*On the Ancient Lake Habitations of Switzerland;* by JOHN LUBBOCK, Esq., F.R.S.*

[The interest attached to the subject of Mr. Lubbock's memoir warrants its republication, as but few American readers have access to the original. M. Morlot, whose researches are alluded to in this article, will be well remembered by the readers of this Journal from his paper entitled 'General views on Archæology,' published in vol. xxix.]

ARCHÆOLOGY forms the link between Geology and History—the past and the present. If in its more recent portions it is scarcely distinguishable from History, yet when we pass back to its commencement, we find ourselves to have imperceptibly glided into the domain of Geology, without noticing any boundary to separate the one from the other. The begining of Archæology being, in fact, but the end of Geology, it is not surprising that they should, in the course of their development, have presented some remarkable analogies. M. Morlot has well pointed these out in his "Leçon d'ouverture d'un cours sur la haute antiquité, fait a l'Academie de Lausanne."

Even, indeed, as the remains of extinct animals were at first supposed to be few and far between, whereas, in fact, the surface of the earth is made up of the dust and skeletons of our predecessors, so the relics of man, long looked upon as rare and exceptional in their occurrence, are gradually presenting themselves in unexpected profusion. Loth, however, to distrust the existing

* From the Natural History Review for January, 1862, p. 26.

chronology, our antiquaries long referred all the most beautiful and well made weapons to the Romans, just as all fossils were attributed to the action of the deluge. Passing on, then, with a graceful compliment to the two of our most eminent contemporaries, M. Morlot points out that as Lyell, the reformer of Zoology, by studying the changes now taking place on the earth's surface, has explained the results which Geology brings before us, and thus arguing from the known to the unknown, has used the Present as a key to unlock the Past; so M. Thomson, by collecting the implements and recording the habits of the existing savages, has thrown much light upon the manners and customs of ancient times. Fully recognizing the imperfection of the record in the one case as well as in the other, we must guard ourselves against any hasty conclusions and generalizations but it seems now to be well established that a considerable elongation of the received chronology is required in Archæology as decidedly, though not of course to such an extent, as in Geology.

Perhaps, also, we may regard it as, to say the least, highly probable, that in Northern Europe there have been three great epochs in the history of man—primary, secondary, and tertiary —the first of Stone, the second of Bronze,* and the third of Iron. This conclusion, which we owe in the first instance to the Northern and especially to the Danish Archæologists, has been much strengthened by the recent researches in the lakes of Switzerland.

It is however probable, as was mentioned in our last number, that the Stone period will require much sub-division. In all classifications we are apt, at first, to take the apparent, for the real dimensions of the more distant portions, and it is only as we obtain a closer acquaintance with them, that we discover their real proportions. Thus, it would appear, that the Stone age must be divided into at least two periods; that of the drift on the one hand, and on the other hand, that to which the Danish Kjökkenmöddings and the Swiss Lake Habitations appear to belong.

These Lake-dwellings or "Pfahlbauten,"—a term whose nearest English equivalent is "Pile-works"—were made known to us in the following manner.

In consequence of the extraordinary dryness and coldness of the weather during the winter months of 1853 and 1854, the rivers of Switzerland did not receive their usual supplies, and the

* In a grave at Mare Hill in Staffordshire, Mr. Carrington found "a piece of lead," having the appearance of wire, which subsequent researches prove to have "been accidentally fused from metalliferous gravel present upon the spot." May not copper have been first obtained from some bright piece of ore, used as an ornament, and burnt with its wearer? The coincidence of a knowledge of metal with the practice of burning the dead is at least significant.

The copper of North American tumuli is plainly traced to the deposits of native copper near Lake Superior.—Eds.

water in the lakes fell much below its ordinary level, so that in some places a broad strand was left uncovered along the margin, while in others shallow banks were converted into islands. The water level of this season was, indeed, the lowest upon record. The lowest level marked on the so-called stone of Stäfa was that of 1674, but in 1854 the water sank a foot lower. These unusual conditions, though very unfavorable to navigation, enabled the Swiss Archæologists to make the important discoveries which we are about to bring before our readers.

M. Aeppli of Meilen, on the Lake of Zurich, appears to have been the first to observe, in the bed of the lake, certain indications of human activity, which he justly supposed might throw some light on the history and condition of the earliest inhabitants of the Swiss valleys. In a small bay between Ober Meilen and Dollikon, the inhabitants took advantage of the lowness of the water to increase their gardens, by building a wall along the new water-line, and slightly raising the level of the piece thus reclaimed, by mud dredged from the lake. In the course of this dredging they found great numbers of piles, of deer horns, and also some implements. The researches at this place conducted and described by Dr. F. Keller, have been followed by similar investigations in other lakes, and have proved that the early inhabitants of Switzerland constructed some, at least, of their dwellings above the surface of the water, as is done in the present day by savages in various countries, as for instance the Papous of New Guinea, whose huts, circular or square in form, are grouped on wooden platforms, elevated a few feet above the level of the water, supported by numerous piles driven into the mud, and connected with the land by a narrow ridge.

This method of construction, indications of which are found in various parts of Europe, was especially mentioned by Herodotus,* who describes the Pœonians of Lake Prasias, in Thrace, as living in cabins situated on a platform, supported above the water by great piles. Each cabin had a trap-door opening on to the lake, and the whole settlement communicated with the main land by a bridge.

The Swiss "*Pfahlbauten*," or lake habitations, have been described by M. Keller, in three memoirs presented to the Antiquarian Society of Zurich, in 1854, 1858, and 1860, and by M. Troyon, in a special work, "Sur les Habitation Lacustres," 1860, in which the author gives a general account of what has been done in Switzerland, and compares the result obtained in his native land, with the lake dwellings of other countries and times. The discoveries in Lake Moosseedorf have been described in a special paper by MM. Jahn and Uhlmann (Die Pfahlbaualterthumer von Moosseedorf. Bern, 1857); and we owe to M.

* Her. Book V, ch. 16.

Rütimeyer to works on the animal remains from the Pfahlbauten the first "Untersuchung der Thierreste aus den Pfahlbauten der Schweiz," published by the Antiquarian Society of Zurich, in 1860; and still more recently a larger work*—Collections of objects from these localities have also been made by many Swiss Archæologists.

The Flora has been studied by M. Heer, whose results are contained in the last memoir published by M. Keller. Nor must we omit to mention M. Morlot's short paper in the "Bulletin de la Societe Vaudoise," and his more recent "Leçon d'Ouverture d'un cours sur la haute Antiquité fait a l'Académie de Lausanne." From the conclusion of this lecture, indeed, I must express my dissent: not that I would undervalue what M. Morlot calls the Practical Utility of Geology, nor that I am less sanguine as to the future advantages of Archæology. Science, however, is like virtue, its own reward, and the improvement of the mind must be regarded as the highest object of study. However this may be, M. Morlot is, to use his own metaphor, laboring earnestly in the vineyard, and is improving the soil, though, as in the old fable, it may be in the false hopes of finding a concealed treasure. The Swiss Archæologists have, indeed, made the most of a golden opportunity, Not only in Lake Zurich, but also in Lakes Constance, Geneva, Neufchatel, Bienne, Morat, Sempach, in fact in most of the large Swiss lakes, as well as in several of the smaller ones (Inkwyl, Pfaffikon, Moosseedorf, Luissel), similar lake habitations have been discovered. In the larger lakes, indeed, not one, but many of these settlements existed; thus, M. Keller mentions, in Lake Bienne, eleven; in Lake Neufchatel, twenty-six; in the Lake of Geneva, twenty-four; in that of Constance, sixteen; and many more, doubtless, remain to be discovered.

The dwellings of the Gauls are described as having been circular huts, built of wood and lined with mud. The huts of the Pileworks were probably of a similar nature. This supposition is not a mere hypothesis, but is confirmed by the preservation of pieces of the clay used for the lining. Their preservation is evidently due to the building having been destroyed by fire, which has hardened the clay and enabled it to resist the dissolving action of the water. These fragments bear, on one side, the marks of interlaced branches, while on the other, which apparently formed the inner wall of the cabin, they are quite smooth. Some of those which have been found at Wangen are so large and so regular that the Swiss Archæologists feel justified in concluding that the cabins were circular, and from ten to fifteen feet in diameter. Though, therefore, the architecture of this period was

* Die Fauna der Pfahlbauten in der Schweiz. Untersuchungen über die Geschichte der wilden und der Haus Saügathieve von Mittel Europe von Dr. L. Rütiemeyer. This work contains a full resumé of the subject up to the present time.

very simple, still the weight to be sustained on the wooden platforms must have been considerable, and their construction, which must have required no small labor,* indicates a considerable population. It would, indeed, be most interesting if we could construct a retrospective census for these early periods, and M. Troyon has made an attempt to do so, though the results must naturally, be somewhat vague. The settlement at Morges, which is one of the largest in the Lake of Geneva, is 1200 feet long and 150 broad, which would give a surface of 180,000 square feet. Taking the cabins as being 15 feet in diameter, and supposing that they occupied half the surface, leaving the rest for gangways, we may estimate the number of cabins at 311, and if we suppose that, on an average, each was inhabited by four persons, we shall have, for the whole, a population of 1244. Starting from the same data, we should obtain for the Lake of Neufchatel, a population of about 5000. Altogether, 68 villages, belonging to the Bronze Age, have been discovered in Western Switzerland, and by the same process of reasoning they may be supposed to have contained 42,500 persons; while for the preceding epoch, the population may, in the same manner be estimated at 31,875.

For a moment it may surprise us that a people so uncivilized should have constructed their dwellings with immense labor on the water, when it would have been so much more easy to have built them on dry land. The first settlers in Switzerland, however, had to contend with the Boar, the Wolf, the Bear, and the Urus; and subsequently, when the population increased, and disputes arose, the lake habitations, no doubt, acted as a fortification, and protected man from man, as they had before preserved him from wild beasts.

Switzerland is not, by any means, the only country in which lake dwellings have been used as fortresses. In Ireland, a number of more or less artificial islands, called "Crannoges,"† are known historically, to have been used as strongholds by the petty chiefs. They are composed of earth and stones, strengthened by numerous piles, and have supplied the Irish Archæologists with numerous weapons and bones. From the Crannoge at Dunshuglin, indeed, more than 150 cart loads of bones were obtained, and were used as manure! These lake dwellings of Ireland, however, come down to a much later period than those of Switzerland, and are frequently mentioned in early history. Thus, according to Shirely, "One Thomas Phelliplace, in his answer to an inquiry from the Government, as to what castles or forts O'Neil hath, and of what strength they be, states (May

* "Increasing density of population is equivalent to increasing facility of production." Bastiat, Harmonies of Political Œconomy, p. 12.

† See Wilde's Catalogue, vol. i, p. 220.

18, 1567): 'For castles, I think it be not unknown unto your honors, he trusteth no point thereunto for his safety, as appeareth by the raising of the strongest castles of all his countreys, and that fortification that he only dependeth upon is *in sartin ffreshwater loghes* in his country, which from the sea there come neither ship nor boat to approach them: it is thought that there in the said fortified islands lyeth all his plate, which is much, and money, prisoners and gages: which islands hath in wars to fore been attempted, and now of late again by the Lord Deputy there, Sir Harry Sydney, which for want of means for safe conducts upon the water it hath not prevailed.'"

Again, the map of the escheated territories, made for the Government, A. D. 1591, by Francis Jobson, or the "Platt of the County of Monaghan," preserved in the State Paper Office, contains rough sketches of the dwellings of the petty chiefs of Monaghan, which "are in all cases surrounded by water."* In the "Annals of the Four Masters," and other records of early Irish history, we meet with numerous instances in which the Crannoges are mentioned, and some in which their position has not preserved them from robbery and destruction; so that we need not be surprised to find that most of the Swiss Lake habitations appear to have been destroyed by fire. Though, however, these latter resemble the Irish Crannoges in their position and use, they differ considerably from them in their construction. In one or two places, indeed, as for instance at the Steinberg, in the Lake of Bienne, it is possible that an island may have been formed, the bottom of the lake having been artificially raised. It is curious that a canoe laden with stones, was actually found near this spot, it having, apparently, sunk with its load, at the time when the Steinberg was in process of construction. After all, however, it seems probable that even in this case, the object was only to obtain a firmer foundation for the piles. At the present time the highest part is eight feet below the surface of the water, and nothing justifies us in looking back to any such alteration of level. Moreover, even now the piles project two or three feet above the surface, upon which, therefore, the cabins cannot have been intended to stand. A small island in Lake Inkwyl, however, reproduces almost exactly the Irish Crannoge.

After having chosen a favorable situation, the first step in the construction of the Lake habitations was to obtain the necessary timber. To cut down a tree with a stone hatchet must have been no slight undertaking. It is, indeed, most probable that they made use of fire, in the same manner as is done by existing savages in felling trees and making canoes. Burning the wood and then scraping away the charred portion, renders, indeed the task far more easy, and the men of the Stone period appear to

* Ibid. p. 231.

have avoided the use of large trees, except in making their canoes. Their piles were imbedded in the mud for from one to five feet, and must also have projected from four to six feet above the water level, which cannot have been very different from at present. They must, therefore, have had a length of from 15 to 30 feet, and they were from 3 to 9 inches in diameter. The pointed extremity which entered into the mud still bears the marks of the fire, and the rude cuts made by the stone hatchets. The piles belonging to the Bronze period being prepared with metal axes, were much more regularly pointed, and the differences between the two have been ingeniously compared to those shown by lead pencils well and badly cut. Draging the piles to the lake, and fixing them firmly, must have required much labor, especially when their number is considered. At Wangen alone M. Lohle has calculated that 40,000 piles have been used; but we must remember that these were probably not all planted at one time, nor by one generation. Wangen, indeed, was certainly not built in a day, but was, no doubt, gradually added to as the population increased. Herodotus informs us that the Pœonians made the first platform at the public expense, but that subsequently at every marriage (and polygamy was permitted), the bridegroom was expected to add a certain number of piles to the common support. In some localities, as at Robenhausen, on Lake Pfeffikon, the piles were strengthened by cross beams. The Pileworks of subsequent periods differ little from those of the Stone age, except, perhaps, that they are more solidly constructed. The piles, also, are less decayed and project above the mud farther than those of the preceeding epoch. M. Morlot considers that the horizontal platform rested upon the top of these piles, at such a height as to allow for all ordinary variations in the level of the water. M. Suter, however, supposes that in some cases, at least, the platform was not attached to the perpendicular piles, but rested upon the water, rising and sinking with it. The structure of the Pileworks at Wauwyl, in the Canton of Lucerne, certainly seems to favor this view. It was composed of four rectangular divisions, separated by narrow channels, over which, no doubt, bridges were thrown, and through which canoes might pass. The piles were less numerous than usual, and were grouped principally around the outer edge of the platforms. In this case they have been preserved by peat; they are from three to four and a half inches in diameter, all rounded, and not formed of split timber. In order to ascertain their length, M. Suter dug up two of them; the longest penetrated four feet through the peat, and ten feet six inches into the ancient bed of the lake; the other, also four feet through the peat, but only four feet six inches lower. M. Suter examined the piles carefully, but fruitlessly, to ascertain any manner in which the platform can have been attached to them.

The platform itself consisted of five layers of trees, curiously and carefully fastened together by clay and interlaced branches of trees, but like the perpendicular piles they were examined in vain for any traces of notches, mortises, holes, ligatures, bolts, or any contrivance, by which the upright piles and the platforms could have been fastened together.

Not only were the debris of their repast, and other rubbish thrown into the water, but more or less valuable weapons and instruments must have been sometimes lost in this manner, especially as children formed, of course, the usual proportion of the population. Many of the articles presently to be mentioned, were however, in all probability, engulphed at the destruction of the Pfahlbauten, some of which were perhaps burnt and rebuilt more than once.

The number of stone implements which have been already found is quite astonishing; at Wangen, in Lake Constance, many hundred weapons of various sorts have been discovered, and a great number also at Moosseedorf, Wauwyl and Robenhausen, in none of which places has a single piece of metal been as yet met with, a fact which, taken in connection with the great number of bronze implements which have been collected from other Pileworks, clearly indicates that the settlements above mentioned belonged to the age of Stone. Not only, however, is metal absent, and not only, as we have already seen, does the Fauna indicate a greater antiquity, but the stone weapons themselves are less varied and less skillfully made. Most of them are made from rocks which occur in Switzerland, though it is probable that the flint was brought from France. The absence of any great blocks of this valuable material in Switzerland accounts for our not finding any of the large, flat axes which are so characteristic of northern Europe, and especially of Denmark. At Wangen, the stone implements resemble those of Moosseedorf, and are principally formed of indigenous rocks, which to judge from the fragments scattered about, were evidently worked up at these two places. One or two bits, however, consisted of Oriental nephrite, which is green, transparent, and of remarkable hardness, and if these really belonged to the Stone age, the fact is very remarkable, as this substance, according to Swiss mineralogists, does not naturally occur in Switzerland, and must have been brought from Egypt or Asia. On this point, however, it would be desirable to have more information; since, if we are to suppose that any such extended commerce existed, it is difficult to understand why bronze and iron were not also introduced. Weapons of nephrite have also been found at one or two other places, belonging to the Bronze age, and where therefore its presence is less inexplicable. The stone impliments found in the settlements belonging to this earliest period consists of ham-

mers, axes, knives, saws, lance heads, arrow heads, corn crushers, and polishing blocks. Some of the hammers were made of serpentine with a hole pierced through one end, and are, like all pierced stones, of very great rarity, belonging perhaps only to the end of the Stone period. Some of them are cylindrical, others more cubical in shape.

The axe was preëminently *the* implement of antiquity. It was used in war and in the chase, as well as for domestic purposes, and great numbers have been found, especially at Wangen, (Lake of Constance) and Concise (Lake of Neufchatel). With a few exceptions they were surprisingly small, especially when compared with the magnificent specimens from Denmark; in length they varied from six inches down even as low as one, while the cutting edge had generally a width of from 15 to 20 lines. Flint was sometimes used, and nephrite, or jade, in a few cases, but serpentine was the principal material. Most of the larger settlements were evidently manufacturing places, and many spoilt pieces and half finished specimens have been found. The process of manufacture is thus described by M. Troyon. After having chosen a stone, the first step was to reduce it by blows with a hammer to a suitable size. Then grooves were made artificially, which must have been a very tedious and difficult operation, when flint knives, sand, a little water, and an unlimited amount of patience, were the only available instruments. Having carried the gooves to the required depths, the projecting portions were removed by a skillful blow with a hammer, and the implement was then sharpened and polished on blocks of sandstone.

Sometimes the hatchet thus obtained was simply fixed in a handle of horn or wood. Generally, however, the whole instrument consisted of three parts. A piece of horn, two or three inches in length, received the stone at one end and was squared at the other, so as to fit into a longer handle either of wood or horn. These intermediate pieces present several variations, some are simply squared, others have a projecting wing which rested against the handle, some few are forked as if to receive a wedge, and one had a small transverse hole apparently for the insertion of a peg.

The knives may be considered as of two sorts. Some differ from the axes, principally in having their width greater than their length. In other cases they were made of flint flakes. In this manner also were obtained the saws, which in addition had their edges somewhat rudely dentated; they were fixed into handles of wood by some sort of cement; but we do not find in Switzerland any of the semilunar saws, which are frequent in Denmark.

The arrow heads were made of flint, or in some cases of rock crystal, and were, as in Ireland, of three principal sorts, between which however, there were a great many varieties. The first sort had a diamond shape, the posterior half of which was, in some specimens, shorter and rounded off. The second sort had the posterior margin more or less excavated, so that the angles being produced, as it were, into wings, clasped the shaft and enabled the arrow head to be more firmly fixed. In the third sort, the middle part of the posterior side had a projection which sunk into the shaft. There are also found rounded stones, pierced with one, or sometimes with two holes. The use of these is uncertain, but they may perhaps have been used to sink fishing lines.

"Waste not, want not," is a proverb which the Lake dwellers thoroughly appreciated. Having caught any wild animal, except the hare, they ate the flesh, used the skin for clothing, picked every fragment of marrow out of the bones, and then in many cases, fashioned the bones themselves into weapons. The larger and more compact ones served as hammers, and, as well as horns of the deer, were used for the handles of hatchets. In some cases pieces of bone were worked to a sharp edge, but they can only have been used to cut soft substances.* Bone harpoons, poignards, arrow heads, and javaline heads also occur, and pins and needles of this material are very common. Teeth also, and particularly those of the wild boar, were used for cutting, and were also, in some cases, worn as ornaments or armlets. There can be little doubt that wood was also extensively used for different purposes, but unfortunately most of the implements of this material have perished. A wooden mallet, however, was found at Concise.

For our knowledge of the animal remains from the Pileworks we are almost entirely indebted to Prof. Rütimeyer, who has published two memoirs on the subject. (Mittheilungen des Antiq. Gesellschaft in Zurich, Bd. xiii, Abth. 2, 1860; and, more recently, a separate work, Die Fauna des Pfahlbauten in der Schweiz, 1861). The bones are in the same fragmentary condition as those from the Kjökkenmöddings, and have been opened in the same manner for the sake of the marrow. There is also the same absence of certain bones and parts of bones, so that it is impossible to reconstruct a perfect skeleton even of the commonest animals.

The total number of species amounts to about 66, of which 10 are fishes, 3 reptiles, 17 birds, and the remainder quadrupeds. Of the latter, eight species may be considered as having been domesticated, namely, the Dog, Pig, Horse, Ass, Goat, Sheep,

* According to Sir E. Belcher, however, sharpened pieces of horn are used by the Esquimaux in the preparation of flint weapons.

and at least two species of Oxen. The bones very seldom occur in a natural condition, but those of domestic and wild animals are mixed together, and the state in which they are found, the marks of knives upon them, and their having been almost always broken open for the sake of the marrow, are all evidences of human interference.

Two species, the one wild, the other domestic, are especially numerous,—the Stag and the Ox. The remains of these two indeed equal those of all others together. It is, however, interesting, that in the older settlements, as Moosseedorf, Wauwyl, and Robenhausen, (Lake Pfeffikon,) the Stag exceeds the Ox in number of specimens indicated, while the reverse is the case in the more modern settlements of the western lakes, as, for instance, those at Wangen and Meilen.

Next to those in order of abundance is the Hog. More sparing again, and generally represented by single specimens where the preceding occur by dozens, are the Roe, the Goat, and the Sheep, which is most numerous in the latter settlements. With these rank the Fox and the Martens. The Fox indeed, appears, whether from choice or necessity, to have been eaten during the Stone period. This conclusion is derived from the fact that the bones often present the marks of knives, and have been opened for the sake of the marrow. While, however, it is very frequent in the Pileworks of the Stone epoch, it has not yet been found in any settlement belonging to the bronze period. Oddly enough the Dog is, at least in the lake dwellings of the Stone period, rarer than the Fox, though more common than the Horse or the Ass; and of other species but few specimens have been met with, though, in some localities, the Beaver, the Badger, and Hedgehog appear in some numbers.

The Bear and Wolf, as well as the Urus, the Bison, and the Elk seem only to have occasionally been captured; it is probable that the latter species were taken in concealed pits.

From the small lake at Moosseedorf, M. Rütimeyer has identified the following list:—Of the Dog, 3 specimens; Fox, 4 specimens; Beaver, 5 specimens; Roe, 6 specimens; Goat and Sheep, 10 specimens; Cow, 16 specimens; Hog, 20 specimens; Stag, 20 specimens.

It is certainly very striking to find two wild species represented by the greatest number of specimens, and particularly so, since this is no exceptional case; but the whole sum of the wild, exceeds that of the domesticated individuals, a result moreover which is confirmed by the other settlements of this epoch. Not only does this indicate a great antiquity but it also proves that the population must have been sometimes subjected to great privations, not only from the necessary uncertainty of supplies so obtained, but also because we cannot suppose that foxes would have been eaten except under the pressure of hunger.

In his first memoir, Prof. Rütimeyer gives an interesting table which I here subjoin, premising that 1 denotes a single individual; 2, several individuals; 3, the species which are common; 4, those which are very common; and 5, those which are present in great numbers. An x indicates a trace, and I have inserted a + in those cases in which the species have occurred since the table was constructed. I may also repeat that Moosseedorf, Wauwyl, Robenhausen, and Wangen belong to the Stone period while Meilen, and Concise were also inhabited during that of the Bronze, and Auvernier and Steinberg have even produced a few weapons of iron.

			STONE.				BRONZE.			IRON.
			Moosseedorf.	Wauwly.	Robenhausen.	Wangen.	Meilen.	Bienne.	Concise.	Auvernier.
1	The Brown Bear	Ursus Arctos	2	...	...	2	+	...	(x)	
2	The Badger	Meles vulgaris	2	2	1	...	x	...	+	
3	The Martin	Mustela Foina	2	3	...	...	...	...	(x)	
4	The Pine Martin	" Martes	2	3	...	...	1	...	(x)	
5	The Polecat	" Putorius	2	2	+					
6	The Ermine	" Erminea	...	2						
7	The Otter	Lutra vulgaris	1	...	+					
8	The Wolf	Canis Lupus	...	1	+	(x)	x	...	+	
9	The Fox	" Vulpes	3	3	1	1	(x)			
10	The Dog	" familiaris	2	2	2	2	3	3	(2)	x
11	The Wild Cat	Felis Catus	2	2	+					
12	The Hedgehog	Erinaceus europœus	1	+	+					
13	The Beaver	Castor fiber	3	2	...	...	...	...	(x)	
14	The Squirrel	Sciurus europœus	2	2	...	1				
15	The Marsh Boar	Sus Scrofa palustris	5	5	5	5	5	2	(x)	
16	The Wild Boar	" " ferus	2	2	2					
17	The Domestic Hog	" " domesticus	...	? 1	...	...	...	3	+	x
18	The Horse	Equus Caballus	? 1	2	...	1	2	3		
19	The Elk	Cervus Alces	1	1	2	...	2	1	(x)	
20	The Stag	" Elaphus	5	5	5	5	5	5	(x)	x
21	The Roe	" Capreolus	4	2	2	2	2	...	(x)	
22	The Fallow Deer	" Dama	...	...	...	...	x ?	x		
23	The Ibex	Capra Ibex	...	...	...	...	1			
24	The Goat	" Hircus	2	2	2	...	...	3-4	(x)	x
25	The Sheep	Ovis Aries	2	1	2	...	(x)	3-4	(x)	x
26	The Urus	Bos primigenius	1	+	2	...	...	...	+	
27	The European Bison	" Bison	...	1						
28	The Ox	" Taurus domesticus	5	5	5	5	5	5	(x)	x
29	The Kite	Falco milvus	...	...	1					
30	The Goshawk	" palumbarius	2	1						
31	The Sparrow hawk	" nisus	2							
32	The Ringdove	Columba palumbus	1							
33	The Wild Duck	Anas boschas	3	1						
34	The Garganey	" querquedula ?	2							
35	The Heron	Ardea cinerea	2	...	1					
36	The freshwater Tortoise	Cistudo europœa	1							
37	The edible Frog	Rana esculenta	3	2	+					
38	The Salmon	Salmo salar	1							
39	The Pike	Esox lucius	3	2	...	...	...			
40	The Carp	Cyprinus carpio	2	...	+					
41	The Bleak	" leuciscus	1							

The additional species added since this table was published are:—

42. The Mouse, M. sylvaticus. A single specimen, from Robenhausen. Our common house-mice and rats seem to have been unknown, and even this species is at present represented by but a single specimen.

43. The Hare, Lepus timidus. Of this species only a single bone has yet occurred. It was found at Moosseedorf. It is very remarkable that any nation should have eaten the Fox and spared the Hare, and nothing but a feeling of superstition can account for such an anomaly, which, however, accords well with the entire absence of the Hare from the Kjökkenmöddings of Denmark.

44. The Chamois, Antilope rupicapra. This species is represented by a piece of skull from Robenhausen.

45. A second race of domestic Oxen.

46. The Ass.

The additional birds which have been discovered are:—

Aquila fulva, Meyer. The Golden Eagle. At Robenhausen.
Aquila haliætus. A single bone found at Moosseedorf is rather doubtfully referred to this species by M. Rütimeyer.
Strix alves. From Concise.
Sturnus vulgaris. " Robenhausen.
Cinclus aquatinus "
Tetrao bonasia "
Ciconia alba. Not unfrequent at Moosseedorf and Robenhausen.
Fulica atra. Robenhausen.
Larus. Sp. in "
Cygnus musicus "
Anser segetum "

The additional species of fish are:—

Perca fluviatilis. Robenhausen.
Scardinius erythropthalmus. "
Chondrostoma nasus. "
Lota vulgaris. "

And one or two species belonging to the genus Squalius.

The common Mouse and our two House rats, as well as the domestic Cat and the Barndoor fowl are absent from the Lake habitations of Switzerland as from Kjökkenmöddings of Denmark; at least Prof. Rütimeyer attributes to a later period a single bone of the latter which was found at Morges, a settlement belonging to the Bronze period.

The bones of the Stag and the Wild Boar often indicate animals of an unusual magnitude, while on the other hand the Fox appears to have been somewhat smaller than at present.

The Dogs varied less than at present, in fact they belong to one variety, which was of middle size, and appears to have resembled our present Beagles. (M. Rütimeyer describes it as "resembling the Jagdhund" and the "Wachtelhund."

The Sheep of the Stone period differed from the ordinary form, in its small size, fine legs, and short, goat-like horns: particulars, in which it is nearly resembled by some northern, and mountain varieties at the present day, as for instance by the small sheep of Shetlands, Orkneys, Welsh hills, and parts of the Alps. At Wauwyl, however, M. Rütimeyer found traces of an individual with large horns.

The number of Wild species of Sheep is so great, and our knowledge of them is so deficient, that M. Rütimeyer does not venture to express any opinion concerning the origin of our domestic varieties except that he is inclined to trace them up to several wild races.

It is singular, that though remains of the Horse have yet been found in all the Pileworks, they are so rare that their presence may almost be considered accidental: thus Wangen has only produced a single tooth, Moosseedorf, a metatarsal bone, which has been polished on one side, Robenhausen, a single os naviculare tarsi and Wauwyl, only a few bones, which may all have belonged to a single specimen. On the other hand, when we come to the Bronze period, we find at Steinberg, numerous remains of this species, so that, as far as these slight indications go, the Horse though undoubtedly present in the Stone age, seems to have been rarer than it became at subsequent periods. All the remains of the Horse belonged undoubtedly to the domestic species.

Though he refers some bones to the Wild Boar, and others to the Domestic Hog, yet he considers that the greatest numbers of the remains of this genus belong to a different race, which he calls Sus scrofa palustris. This variety was, in his opinion, less powerful and dangerous than the Wild Boar, the tusks being much smaller in proportion; in fact he describes it as having with the molar teeth of an ordinary full grown Wild Boar, the premolars, canines, and incisives of a young Domestic Hog. He considers that all the bones of this variety from Moosseedorf, belonged to wild individuals, while of those from Nidau-Steinberg, Robenhausen, Wauwyl, and Concise, some bore in his opinion evidences of domestication. It has been supposed by some naturalists that this variety was founded only on female specimens, but in his last work, M. Rütimeyer combats this opinion at some length, and gives copious descriptions and measurements of different parts. He also points out numerous sexual differences in the S. palustris, of the same nature, but not so well marked, as those of the Wild Boar. Relying also on its well defined geographical and historical range, he denies that it can be considered as a cross between the Wild Boar and Domestic Hog, or that the differences which separate it from the former, can be looked upon as mere individual peculiarities. He considers, indeed, that as a wild animal it became extinct at a very early period, though the tame

Swine of India which agree closely with this race may perhaps have been descended from it.

Our Domestic Hog first makes its appearance in the later Pileworks, as for instance at Concise. M. Rütimeyer does not, however, consider that it can have been derived from the Wild Boar (Sus scrofa), nor does he think that it was tamed by the inhabitants of Switzerland, but is rather disposed to look upon it as having been introduced, and the more so, as he finds at Concise traces of an Ox (*B. trochoceros*) which does not occur in the earlier Pileworks. In considering whether a given animal was wild or domesticated, we must be guided by the following considerations; the number of individuals represented; the relative proportions of young and old; the absence or presence of very old individuals, at least of species that served for food; the traces of long, though indirect, selection, in diminishing the size of any natural weapons which might be injurious to man; the direct action of man during the life of the animal; and finally the texture and condition of the bones.

Applying these considerations to the Sus palustris from Moosseedorf, it is evident, firstly, that the argument derivable from the number of young specimens loses much of its force on account of the great fertility of the Sow, and the ease with which the young can be found and destroyed; secondly, in the number of individuals represented, it is equalled by the Stag, which certainly was never domesticated; thirdly, some bones of very old individuals have been found and some of very young, even of unborn pigs; the smallness of the tusks is, according to M. Rütimeyer, a characteristic of the race and not an evidence of domestication; the bones are of a firm and close texture, and the only cases of decay have arisen from an extreme degradation of the teeth, which would certainly be unlikely to occur in a domestic animal. Finally, none of the teeth show traces of any filing or other preparation, except such as may have taken place after the death of the animal, from all of which reasons M. Rütimeyer infers that the inhabitants of Moosseedorf had not yet succeeded in taming either the Sus scrofa palustris or the Sus scrofa ferus.

M. Rütimeyer has paid great attention to the texture and condition of the bones themselves, and in many cases can from these alone distinguish the species, and even determine whether the bone belonged to a wild or a domesticated animal.

In wild animals the bones are of a firmer and closer texture, there is an indiscribable, but to the accustomed eye very characteristic, sculpturing of the external surface, produced by the sharper and more numerous impressions of vessels and the greater roughness of the surfaces for the attachment of muscles. There is also an exaggeration of all projections and ridges, and a diminution of all indifferent surfaces. In the consideration of the

remains of Oxen, these distinctions have proved of the greatest importance. By their assistance, and this is in some respects the most interesting part of the work, M. Rütimeyer has convinced himself that besides the two wild species of Bos, namely the Urus (*B. primigenius*) and the Aurochs (*B. bison* or *bison Europeus*), three domestic races of Oxen occur in Pileworks.

The first of these is allied to, and in his opinion descended from, the Urus, and he therefore calls it the Primigenius race. This variety occurs in all the Pileworks of the Stone period. The second or Trochoceros race, he correlates with a fossil species described under this name by F. von Meyer, from the Diluvium of Arezzo and Siena. This variety has hitherto only been found at Concise.

The third, or Longifrons race, is by far the most common of the three. It occurs in all the Pileworks, and at Moosseedorf and Wangen—that is to say, in the settlements which are supposed to be the oldest, almost to the exclusion of the Primigenius race. M. Rütimeyer considers that it is the domesticated form of *B. longifrons* of Owen, but as the word "longifrons" seems to him to be inappropriate and incorrect, he uses the name "brachyceros," which was originally proposed in manuscript by Owen for this species, but which has also been used by Gray for an African species, and ought not therefore to be adopted.

A subsequent portion of the work is devoted to the examination of the existing races of European Oxen. The old Trochoceros race he considers to be extinct, but he sees in the great Oxen of Friesland, Jutland, and Holstein, the descendants of the Bos primigenius. This race does not now occur in Switzerland, but he considers that there are at present in that country two distinct varieties of Domestic Oxen. The one of various shades between light grey and dark brown, but without spots, and prevailing in Schwyz, Uri, Wallis, &c., in fact, in the whole country south of a line drawn from the Lake of Constance to Wallis, agrees in its general osteological characters with the Bos longifrons of Owen. The other or spotted variety, which is generally of smaller size, and prevails in Northern Switzerland, is considered by M. Rütimeyer to be descended from the B. frontosus, a species found fossil in Sweden and described by Nillson.

I will not express any opinion of my own as to these conclusions. The subject is one no less difficult than important, and our space does not permit us to lay before our readers the details given by M. Rütimeyer, to whose work therefore we must refer all those who wish for more information on the subject. All naturalists must feel much indebted to M. Rütimeyer for the labor he spent, and the light he has thrown upon the subject, whether we eventually adopt his conclusions or not.

Human bones occur in the Pileworks but very seldom, and may no doubt be referred to accidents, especially as we find that those of children are most numerous. One mature skull was, however discovered at Meilen, and has been described by Professor His, who considers that it does not differ much from the ordinary Swiss type. And while his work was in the press, M. Rütimeyer received from M. Schwab four more skulls, two of which were obtained at Nidan Steinberg, one at Sutz, and one from Biel.

M. Troyon has a very interesting chapter on the different modes of burial; he points out that the disposition of the corpse after death, had a deep meaning and is perhaps of greater importance than the nature of the tomb, which must in many cases have depended upon that of the materials which came to hand. The Greeks generally burnt their dead; considering fire as the means of purification, while the Persians shrank from such an act, regarding fire, according to Herodotus, as a deity. Other nations, looking upon the earth as the universal mother, returned into her bosom the remains of their dead, fortunately ignorant of the deduction that as we brought nothing into the world so we can take nothing out of it, and regarding it therefore as a sacred duty to bury with the departed his most useful weapons and most beautiful ornaments. This belief seems to have been almost as general as the hope of a resurrection, and even among the Jews we find a trace of it in the words of Ezekiel (ch. xxxii, 27). "And they shall not lie with the mighty that are fallen of the uncircumcised, which are gone down to hell with their weapons of war."

In tombs of the Stone age the corpse appears to have been almost always, if not always, buried in a sitting position, with the knees brought up under the chin, and the hands crossed over the breast.* This attitude occurs also in many Asiatic, African, and American tombs. M. Troyon, quotes the following passage from a work published by André Thévet, in 1575; "Quand donc (speaking of the Brazilian aborigines), leurs parents sont morts, ils les courbent dans un bloc et monceau dans la lit oú ils sont décédés, tout ainsi que les enfants sont au ventre de la mére, puis ainsi enveloppés, liés et garrottés de cordes, ils les mettent dans une grande vase de terre." M. Troyon adds, "Chez certains Indiens, les méres, aprés avoir donné á l'homme, avant de l'inhumer l'attitude qu'il avait dans le sein maternel, epanchent

* See for Denmark, Worsaae's Antiquities, Eng. Edit. p. 89. To judge from Mr. Bateman's excellent volume just published, "Ten years diggings in Celtic and Saxon Gravehills," the same position was, to say the least of it, very common in early British Tombs, in which also the corpse was generally deposited on its left side. It would be very interesting if some archæologist would tabulate all the accounts of ancient graves, showing the ornaments and weapons which have been found with different methods of interment.

leur lait sur la tombe. Cet usage des mères, qui assimile l'homme aprés sa mort au petit enfant qu'elles nourrisent de leur lait, s'est conservé, sauf l'attitude, il est vrai, jusqu'au commencement de ce siécle, dans le centre de l'Europe, dans la vallée alpestre des Ormonts;" making this last statement on the authority of M. Terrise, who was himself an eye witness of this extraordinary custom.

Making allowance for the marine animals, such as the seals and oysters, the cockles, whelks, &c., the fauna thus indicated by the remains found in the Swiss lakes, agrees remarkably with that which characterizes the Danish Kjökkenmöddings, and belongs evidently to a far later age than that of the celebrated stone hatchets, which were first made known to us by the genius and perseverance of M. Boucher de Perthes.*

Instead of the Elephant and Rhinoceros we find in the latter or second Stone period, in that namely of the Kjökkenmödding and "Pfahlbauten," the Urus and Bison, the Elk and the Red deer already installed as monarch of the forests. The latter indeed, with the Boar, appears to have been very frequent, and to have formed a most important article of food to the Lake dwellers. The Urus, or great fossil Ox is now altogether extinct. It was mentioned by Cæsar, who describes it as being little smaller than an elephant. (Hi sunt magnitudine paulo infra elephantos, specie et colore et figura tauri.) According to Herberstein, it still existed in Switzerland during the sixteenth century, soon after which, however, it must have become extinct.

The Aurochs, or European Bison seems to have disappeared from Western Europe even earlier than the Urus. There is no historical record of its existence in England or Scandinavia. In Switzerland we cannot trace it later than the tenth century, but it is mentioned in the "Niebelungen Lied," of the twelfth century, as occurring in the Forest of Worms, and in Prussia the last was killed in the year 1775. At one period indeed, it appears to have inhabited almost the whole of Europe, much of Asia, and part even of America, but at present it is confined in Europe, to the imperial forests in Lithuania, where it is preserved by the Emperor of Russia, while, according to Nordmann and von Baer, it still exists in some parts of Western Asia.

We have no notice of the existence of the Elk in Switzerland during the historical period, but it is mentioned by Cæsar as existing in the great Hercynian forest; and even in the twelfth century it was to be met with in Sclavonia and Hungary, according to Albertus Magnus and Gesner. In Saxony, the death of the last is recorded as having occurred in 1746. At present it inhabits Prussia and Lithuania, Finland and Russia, Scandinavia and Siberia, to the shores of the Amoor.

* Whether the Drift race of men were really the aboriginal inhabitants of Europe, still remains to be ascertained. M. Rütimeyer hints, that our geographical distribution indicates a still greater antiquity for the human race.

The Ibex disappeared from most of the Swiss Alps, perhaps not much later than the Elk. It lingered longest in the West. In Glarus the last one perished in 1550, though near Chiavenna it existed until the commencement of the 17th century, and in the Tyrol until the second half of the 18th, while it still maintains itself in the mountains surrounding Mont Iséran.

The extermination of the Bear, like that of the Ibex, seems to have begun in the East, and not yet to be complete, since this animal still occurs in the Jura, in Wallis, and in the South Eastern parts of Switzerland.

The Fox, the Otter, and the different species of Weasels, are still the common carnivora of Switzerland, and the Wild Cat, the Badger, and the Wolf still occur in the Jura and the Alps, the latter in cold winters venturing even into the plains.

The Beaver on the contrary has at last disappeared. It has long been very rare in Switzerland, but a few survived until the beginning of the present century, in Lucerne and Wallis. Red deer were abundant in the Jura and Black Forest in the twelfth and thirteenth centuries, though they do not appear to have been so large as those which lived in earlier times. The last was shot in Basle, at the close of the eighteenth century, while in Western Switzerland and Wallis they lingered somewhat longer. The Roedeer still occurs in some places.

The fauna thus indicated is certainly very much what might have been expected. We find most of the species which charterize the post-tertiary epoch in Europe. Some of the larger ones have since fallen away in the struggle for existence, and others are becoming rarer and rarer every year, while some maintain themselves even now, thanks only to the inclemency and inaccessibility of the mountainous regions which they inhabit. The gradual process of extermination which has continued ever since, had however even then begun.

Taken as a whole, therefore, the animals of the Swiss Pileworks belong evidently to the Fauna, which commenced in post Tertiary times with the Mammoth, the Rhinoceros tichorhinus, the Cave Bear and the fossil hyena. These extinct species appear to have coëxisted in Europe with all of its present indigenous inhabitants; it was, indeed, long supposed that man belonged to a subsequent period, but recent investigations have shown, that he is no exception to the rule.

While, however, we must regard the Fauna of the Stone age as belonging to the same Zoological epoch with that of the later drifts on the one hand, and the present time on the other; we cannot forget that the immense time which had elapsed since the end of the Tertiary period, has produced great changes in the Fauna of Europe. In this Post-tertiary era the Pileworks occupy, so to say, a middle position. Distinguished from the pres-

ent Fauna of Switzerland in the possession of the Urus, the Bison, the Elk, the Stag, and the Wild Boar, as well as by the more general distribution of the Beaver, the Wolf, the Ibex, the Roe, &c., they differ equally from the drift gravels in the absence of the Mammoth, the Rhinoceros, the Cave Bear, and the Cave Hyena.

M. Rütimeyer, however, thinks that we may carry this division farther, and he considers that some of the Pileworks presenting a more archaic character than others, they may be arranged as follows:—

1stly, Moosseedorf.

2ndly, As being somewhat more recent, Wauwyl, Robenhausen, Wangen, and Meilen.

3dly, The Lake habitations of Western Switzerland.

It is of course unnecessary to point out the interest and importance of such a distinction, which accords so well with that indicated by the study of the weapons and the state of preservation of the piles. Thus, the Urus has only occurred at Moosseedorf and Robenhausen; the Aurochs only at Wauwyl; the Bear only at Moosseedorf and Meilen. A glance at the table given at page 172, will show that several other species have as yet only occurred at Moosseedorf and Robenhausen, a fact however which indicates rather the richness than the antiquity of these localities. Possibly indeed we may consider the presence of these larger species as an indication of their greater abundance in the oldest period; but we must not forget that not only the Bear and the Elk, but also the Aurochs and Urus come down to a much later period. On the other hand, the abundance of wild animals, and the fact that at Moosseedorf and Wauwyl the Fox was more abundant than the Dog, while elsewhere the reverse is the case, certainly speaks in favor of the greater antiquity of these two settlements.

The evidence derived from the distribution of the domestic animals is perhaps more satisfactory. The Sheep is present even at Moosseedorf, though not so numerous as at the Steinberg. On the other hand, the Horse is frequent at the Steinberg, while at Moosseedorf only a single tooth was discovered, and even this had been worn as an amulet or an ornament, and may have been brought from a distance. Finally, the domestic Hog of the present race is absent from all the Pileworks of the Stone period, excepting perhaps the one at Wauwyl, and becomes frequent only at the Steinberg.

If succeeding investigations confirm the conclusions thus indicated, we may perhaps conclude that the domestic animals, which were comparatively rare in the Stone period, became more frequent after the introduction of bronze, a change indicating and perhaps producing an alteration of habits on the part of the inhabitants.

Rare, indeed, as they may have been, Oxen, Horses, Sheep and Goats could not be successfully kept through the winter in the climate of Switzerland, without stores of provision and some sort of shelter. A pastoral people, therefore, must have reached a higher grade than a mere nation of hunters. We know, moreover, in another manner, that at this period agriculture was not entirely unknown. This is proved in the most unexpected manner, by the discovery of carbonized Cereals at various points. Wheat is most common, having been found at Meilen, Moosseedorf, and Wangen. At the latter place, indeed, many bushels were found, the grains being united in large thick lumps. At other times the grains are free, and without chaff, resembling our present wheat in size and form, while more rarely they are still in the ear. Ears of the Hordeum hexastichon L. (the six rowed Barley) are somewhat numerous. This species differs from the H. vulgare L. in the number of rows and in the smaller size of the grains. According to De Candolle, it was the species generally cultivated by the ancient Romans, Greeks, and Egyptians. In the ears from Wangen, each row has generally ten or eleven grains which however are smaller and shorter than those now grown.

Still more unexpected was the discovery of bread, or rather cakes, for leaven does not appear to have been used. They were flat and round, from an inch to 15 lines in thickness, and, to judge from one specimen, had a diameter of four or five inches. In other cases the grains seem to have been roasted, coarsely ground between stones, and then either stored up in large earthenware pots, or eaten after being slightly moistened. A similar mode of preparing grain was used in the Canary Islands at the time they were conquered by Spain, and even now constitutes the principal food of the poorer classes. In what manner the ground was prepared for the cultivation of corn we know not, as no agricultural implements have as yet been found except sickles; it is probable however that bent stakes supplied the place of the plough.

Carbonized Apples and Pears have also been found at Wangen, sometimes whole, sometimes cut in two, or more rarely into four pieces, which had evidently been dried and put aside for winter use. The apples are more frequent than the pears, and have been found not only at Wangen, but also at Robenhausen in Lake Pfeffikon, and at Concise in Lake Neufchatel. Both apples and pears are small and resemble those which still grow wild in the Swiss forests. No traces of the Vine, the Cherry, or the Damson have yet been met with, but stones of the Wild Plum and the Prunus padus have been found. Seeds of the Raspberry and Blackberry and shells of the Hazel nuts and beechnuts occur plentifully in the mud.

From all this, therefore, it is evident that the nourishment of the dwellers in the Pileworks consisted of corn and wild fruits, of fish, and the flesh of wild and domestic animals. Doubtless also milk was an important article of their diet.

The list of plants found in the Pileworks stand as follows:—

Pinus abies.
" picea.
" sylvestris.
Quercus Robur.
Fagus sylvaticus.
Populus tremula.
Betula alba.
Alnus glutinosa.
Corylus avellana.
Prunus spinosa.
" padus.
Rubus idæus.
" fruticosus.
Wheat.
Hordeum distichum.
" hexastichon.

Trapa natans.—This species was supposed to be extinct in Switzerland; but, as M. Troyon informs me by letter, it has recently been discovered in a living condition. It has, however, become very rare.

Flax, Hemp, Juncus, Arundo.

Neither Oats nor Rye have yet been found. Small pieces of twine and bits of matting made of hemp and flax may have been parts of some article of clothing. For the latter purpose also there can be little doubt that the skins of animals were used, and some of the stone implements seem well adapted to assist in their preparation, while the bone pins, and the needles made from the teeth of boars, may have served to fasten them together.

The Pottery of the Stone age presents nearly the same characters in all the settlements. Very rude and coarse, it is generally found in broken pieces, and a few entire vessels have been obtained. The potter's wheel seems to have been unknown, and the baking was very imperfect. The form was frequently cylindrical, but several of the jars were rounded at the base, and without feet. The rings of pottery, which at a later epoch were used as stands, for these earthern *tumblers* are not found in the Lake habitations of the Stone period, but some of the vessels had small projections which were pierced in such a manner that strings might be passed through them, and the vessels might in this manner be suspended. Some of them were also pierced by small holes at different levels. Professor Heer suggests that these may have been used in the preparation of curds, the small holes being intended to permit the escape of the milk.

Several of the vessels are ornamented with simple markings, generally mere impressions of the finger or of the nail. Neither in the Stone, nor in the Bronze period, do we ever find either in the pottery, or on the bronze weapons, any representation, however rude, of an animal; the ornamentation being generally confined to straight or curved lines, forming in many cases a very elegant ornament. One vase, however, which was found at Wangen, is distinguished by more elaborate ornaments, the lines being evidently intended to represent leaves.

The lakes on which Pileworks of the Stone era have as yet been found, are Constance, Zurich, Bienne, Neufchatel, Geneva, Inkwyl, Nussbaumen, Pfeffikon, Moosseedorf, and Wauwyl. Settlements of the Bronze period existed on the Lakes of Geneva, Luissel, Neufchatel, Morat, Bienne, and Sempach, but none have as yet been found on Lake Constance. It has been supposed from this that the age of Stone lasted longer in Eastern than in Western Switzerland, and that flint and serpentine were in use on Lake Constance long after Bronze had replaced them on the Western Lakes. We can hardly suppose that the inhabitants of Inkwyl and Moosseedorf in Berne, who imported flint from France, can have been ignorant of the neighboring civilization on the Lake of Bienne. Perhaps, however, settlements of the Bronze age may yet be found on the Lake of Constance; but as the question now stands, Pileworks of the Metallic period are peculiar to the Western and Central Switzerland. The constructions of the latter period are more solidly built, but do not otherwise appear to have differed materially from those of the Stone age. They are often, however, situated farther from the land and in deeper water, partly no doubt on account of the greater facility of working timber, but partly also, perhaps, because more protection was needed as the means of attack were improved. The principal implements of Bronze are, swords, daggers, axes, spear heads, knives, arrow heads, pins, and ornaments. The number of these weapons which have been discovered is already very great.

From the settlement at Estavayer, in Lake Neufchatel, the following collection of bronze implements has been obtained:—

Pins with large spherical and ornamented heads, 36; Pins with ordinary heads, 92; Knives, 26; Bracelets, 15; Sickles, 5; Axe, 1; Hook, 1; Chisel, 1; Small rings, 27; Buttons, 2; Dagger blade, 1; Arrow head, 1; Pieces of spiral wire, 6; making altogether, 214 objects of bronze.

Again at Morges (Lake of Geneva) forty-two bronze hatchets and thirteen pins have been found. From the Steinberg M. Schwab has obtained five hundred bronze hair-pins, besides other instruments of the same metal. These are of the same type as those found in other parts of Europe, and the swords are characterized, as usual, by the small space allowed for the hand. They were, however, made in Switzerland, as is shown by the discovery at Morges of a mould for celts, and at Estavayer of a bar of tin.

The pottery of this period was more varied and more skillfully made than that of the Stone age, and the potter's wheel was already in use. Rings of earthenware are common, and appear to have been used as supports for the round bottomed vases. As neither copper nor tin occur in Switzerland, the possession of

bronze implies the existence of commerce. It is difficult to say from whence the copper was obtained, but Saxony and Cornwall are the only parts of Europe which produce tin. It is however, possible that Asia may have supplied both the one and the other. The presence of amber shows that there must have been a certain amount of communication with Northern Europe.

The Pileworks of Switzerland appear to have become gradually less numerous. During the Stone age they were spread over the whole country. Confined during the Bronze era to the Lakes of Western Switzerland, during that of Iron, we find them only on the Lakes of Bienne and Neufchatel. In these settlements not only has a new substance made its appearance but the forms of the implements are different. We have indeed copies of the bronze axes made in iron, just as we found before that the early bronze celts were copies of the still earlier stone axe, but these are exceptional cases. The swords have larger handles and are more richly ornamented; the knives have straight edges; the sickles are larger; the pottery is more skillfully made and is ornamented with various colors; the personal ornaments are also more varied, and glass for the first time makes its appearance.

Col. Schwab has found at the Steinberg more than twenty crescents, made of earthenware, and with the convex side flattened, to serve as a foot. They are compressed at the sides, sometimes plain, sometimes ornamented, from eight to twelve inches from one horn to the other, and from six to eight inches in height. They are considered by Dr. Keller to be religious emblems, and are taken as evidence of moon-worship. He refers to Pliny, xvi. 95; "Est autum id (viscum) rarum admodum inventu et repertum magna religione petitur et ante omnia sexta luna, quæ principia mensum annorumque his facit, et sæculi post tricesimum annum quia jam virium abunde habeat nec sit sui dimidia; *omnia sanantem appelantes suo vocabulo.*" This passage he translates as follows: "The misletoe is however very rare, but when it is found it is gathered with great religious ceremony, especially on the sixth day of the moon, at which epoch begin their months, years, and divisions of thirty years, because it has then sufficient force, and yet is not in the middle of its course; calling it Heal-all in their language." This name has generally been referred to the misletoe. (See The Celt, Roman and Saxon, p. 48.) But the Swiss archæologists consider that this is a mistake, and that it properly refers to the moon.

A field of battle at Tiefenau, near Berne, is remarkable for the great number of iron weapons and implements which have been found on it. Pieces of chariots, about a hundred swords, pieces of coat of mail, lance heads, rings, fibulæ, ornaments, utensils, pieces of pottery and of glass, accompanied by more

than thirty pieces of Gaulish and Massaliot money anterior to our era, enable us to refer this battle field to the Roman era.

After this period we find no more evidences of Lake habitations on a larger scale. Here and there indeed a few fishermen may have lingered on the half destroyed platforms, but the wants and habits of the people had changed, and the age of Pileworks was at an end.

We have, however, traced them through the Stone and Bronze down to the beginning of the Iron period. We have seen evidences of a gradual progress in civilization, and improvement in the arts, an increase in the domestic animals, and proofs at last of the existence of an extended commerce. We found the country inhabited only by rude savages and we leave it the seat of a powerful nation. Changes so important as these are not effected in a day; the progress of the human mind is but slow; and the gradual additions to human knowledge and power like the rings in trees, enable us to form some idea how distant must be the date of their commencement. So varied however are the conditions of the human mind, so much are all nations affected by the influence of others, that when we attempt to express our impressions, so to say, in terms of years, we are baffled by the complexity of the problem, and can but confess our ignorance. Occasionally indeed we obtain a faint glimmer of light but the result is only to show us obscurely a long vista, without enabling us to define any well marked points of time. Thus in Denmark we found three periods of arborescent vegetation, corresponding to the three epochs of human development, and we know that the extermination of one species of forest tree and its replacement by another is not the work of a day. The Swiss archæologists, however, have attempted to make an estimate somewhat more definite than this.

The torrent of the Tinière* at the point where it falls into the Lake of Geneva, near Villeneuve, has gradually built up a cone of gravel and alluvium. In the formation of the railway this cone has been bisected for a length of one thousand feet, and to a depth in the central part, of about thirty-two feet six inches above the level of the rails. The section of the cone thus obtained shows a very regular structure, which proves that its formation was gradual. It is composed of the same materials (sand, gravel, and larger blocks) as are even now brought down by the stream. The detritus does indeed differ slightly from year to year, but in the long run the differences compensate for one another, so that when considering long periods and the structure of the whole mass, the influences of these temporary variations, which arise from meteorological causes, altogether disappear, and

* See Morlot, Leçon d'Ouverture, &c.

need not therefore be taken into account. Documents preserved in the archives of Villeneuve show that in the year 1710 the stream was dammed up and its course a little altered, which makes the present cone slightly irregular. That the change was not of any great antiquity is also shown by the fact that on the side where the cone was protected by the dykes, the vegetable soil, where it has been affected by cultivation, does not exceed two to three inches in thickness. On this side, thus protected by the dykes, the railway cutting has exposed three layers of vegetable soil, each of which must, at one time, have formed the surface of the cone. They are regularly intercalated among the gravel, and exactly parallel to one another, as well as to the present surface of the cone, which itself follows a very regular curve. The first of these ancient surfaces was followed on the south side of the cone, over a surface of 15,000 square feet; it had a thickness of four to six inches, and occurred at a depth of about four feet (1·14 metre measured to the base of the layer) below the present surface of the cone. This layer belonged to the Roman period, and contained Roman tiles, and also a coin.

The second layer was followed over a surface of 25,000 square feet; it was six inches in thickness and lay at a depth of 10 feet (2·97 metres, also measured to the bottom of the layer). In it have been found several fragments of unvarnished pottery, and a pair of tweezers in bronze, which to judge from the style belonged to the Bronze epoch. The third layer has been followed for 3500 square feet; it was six or seven inches in thickness, and lay at a depth of 19 feet (5·69 meters) below the present surface; in it were found some fragments of very rude pottery, some pieces of charcoal, some broken bones, and a human skeleton with a small, round, and very thick skull. Fragments of charcoal were even found a foot deeper, and it is also worthy of notice that no trace of tiles was found below the upper layer of earth.

Towards the centre of the cone, the three layers disappear, since, at this part, the torrent has most force, and has deposited the coarsest materials, even some blocks as much as three feet in diameter. The farther we go from this central region the smaller are the materials deposited, and the more easily might a layer of earth, formed since the last great inundations, be covered over by fresh deposits. Thus, at a depth of ten feet, in the gravel on the south of the cone, at a part where the layer of earth belonging to the bronze age had already disappeared, two unrolled bronze implements were discovered. They had probably been retained by their weight, when the earth, which once covered them, was washed away by the torrent. After disappearing towards the centre of the cone, the three layers reappear on the north side, at slightly greater depth, but with the same regularity

and the same relative position. The layer of the Stone age was but slightly interrupted, while that of the Bronze era was easily distinguishable by its peculiar character and color.

Here, therefore, we have phenomena so regular, and so well marked that we may apply to them a calculation, with some little confidence of at least approximate accuracy. Making then some allowances, for instance, admitting three hundred years instead of one hundred and fifty, for the period since the embankment, and taking the Roman period as representing an antiquity of from sixteen to eighteen centuries, we should have for the age of Bronze an antiquity of from 2900 to 4200 years, for that of the Stone period from 4700 to 7000 years, and for the whole cone an age of from 7400 to 11,000 years. M. Morlot thinks that we should be most nearly correct in deducting two hundred years only for the action of the dykes, and in attributing to the Roman layer an antiquity of sixteen centuries, that is to say, in referring it to the middle of the third century. This would give an age of 3800 years for the Bronze age and 6400 years for that of Stone, but on the whole he is inclined to suppose for the former an antiquity of from 3000 to 4000 years, and for the latter of from 5000 to 7000 years.

In the settlement at the foot of Mt. Chamblon we have, according to M. Troyon, a second instance in which we obtain at least some approximation to a date. The interest which attaches to this case arises from the fact that Pileworks have been found in the peat at a considerable distance from the lake, whereas it is evident that at the time of their construction the spot in which they occur must have been under water, as this mode of building would have been quite out of place on dry land. This however indicates a very considerable antiquity, since the site of the ancient city Eburodunum must have been, at that time, entirely covered by the lake, and yet the name, which is of Celtic origin, denotes that there was a town here even before the Roman period. In order, however, to form an idea of the time at which the dwellings at Chamblon were left dry by the retirement of the lake, we must have in the valley a point of determined age, to serve as a term of comparison, and such a point we find in the ancient city of Eburodunum (Yverdon), which was built on a *dune* extending from Jorat to the Thiéle. Between this *dune* and the lake, on the site at present occupied by the city of Yverdon no traces of Roman antiquities have ever been discovered, from which it is concluded that it was at that period under water. If then we admit that at the close of the fourth century the lake washed the walls of the Castrum Eburodense, we shall have fifteen centuries as the period required to effect this change. The zone thus uncovered in fifteen hundred years is 2500 feet in breadth, and as the piles at Chamblon are at least 5500 feet from the water, it may be inferred that three thousand three hundred

years must have elapsed since they were left dry. This Lake dwelling belonged to the Bronze period, and the date thus obtained, agrees pretty well with that obtained from the examination of the Cone de la Tinière. M. Troyon adds that "rien ne fait soupçonner, pendant l'époque humaine et antérieurement a notre ére, des conditions d'accroisement differentes de celles qui ont eu lieu posterieurement aux Romains; le résultat obténu est même un minimum, vu que la vallée va se rétrécissant du côté du lac et que nous avons admis la présence de celui-ci au pied même d'Eburodunum dans le IV^{e} siècle de l'ère chretienne, tandis qu'il est probable que la retraite des eaux n'a pas été insensible depuis le moment où les Romains se sont fixès sur ce point."

However this may be, and while freely admitting in how many respects this calculation is open to objection, we may still observe that the result agrees in some measure with that given by the Cone de la Tinière. The ancient history of Greece and Rome, as far as it goes, tends to confirm these dates, since we know that at the time of Homer and Hesiod, arms were in part at least, made of iron, and as we know that at a very early period, there was a certain amount of commerce between Helvetia and the shores of the Mediterranean, we can hardly suppose that a metal so immensely important as iron, can have remained unknown in the former country, long after it was generally used throughout the latter.

Still, though we must not conceal from ourselves the imperfection of archæological record, we need not despair of eventually obtaining some more definite chronology. Our knowledge of primitive antiquity has made an enormous stride in the last ten years, and the future is full of hope. I am glad to hear from M. Troyon that the Swiss archæologists are continuing their labors. They may feel assured that we in England await with interest the results of their investigations.

ART. XVII.—*Upon the structure of the Brain in Man and Monkeys, and its bearing upon classification, with special reference to the views of Owen, Huxley and Gratiolet;* by R. WAGNER.*

OWEN has proposed a subdivision of the mammals [see this Journal for 1848, pp. 7 and 177] founded upon the structure of the brain and more particularly upon that of the cerebrum and the presence or absence of gyrations upon it. The two lower of the four sub-classes he makes, the Lyencephala and Lissencephala, including the Monotremata, Marsupialia, Rodentia, Insectivora, Cheiroptera and Edentata, have the hemispheres of the

* From Archiv f. Naturgeschichte, 1861.

brain smooth or nearly so and the corpus callosum wanting or rudimentary, in which characters they approach the Ovipara and especially the birds. Some orders are thus removed from their former higher position. The Quadrumana, Carnivora, Solidungula, Ruminantia, Pachydermata, and Cetacea, form the second of his upper sub-classes or the Gyrencephala. In them the brain, excepting in the small clawed monkeys [Lemurs and Ouistits?], is strongly grooved and has a well developed corpus callosum, and by their higher faculties they are connected with man as his servants and companions. In man the cerebrum at a still higher stage of development spreads itself to a greater degree over the ethmoid lobe, [Riechlappen] and the cerebellum and even develops into the so-called third lobe of the cerebrum. This third or posterior lobe together with the posterior horn of the lateral ventricle and the pes hippocampi minor he regards as peculiar to man, who therefore constitutes not as hitherto merely an order, but a sub-class, the Archencephala. Owen remarks further that he cannot regard man and monkeys so distinct as does the author of Records of Creation, but as Linné and Cuvier have done, must consider them fit subjects for zoologic comparison and classification, especially as he is unable to distinguish in the mental phenomena of a chimpanzee and a bushman or half formed aztec other than differences of degree.

Owen's views appear to me somewhat altered in his communication at the last meeting of the British Association at Oxford, as reported in the Athenæum. He there said that the brain of the gorilla differed more from that of man than did that of the lowest and most problematic quadrumane, since there were parts in the human brain wholly wanting in the gorilla.

At the same meeting Huxley, in opposition to the views of Owen, denied that there is any such vast difference of structure between the brain of man and monkeys and referred to the dissections and figures of Tiedemann in support of his statement. He thought the difference between man and the highest apes in regard to the brain structure not to be so great as that between the highest and lowest apes. More recently in the "Natural History Review" for January, 1861, he has developed the same argument quite at length. Huxley maintains against Owen: 1. That the posterior lobe is not peculiar to man and is found in all quadrumanes; 2. That the posterior horn of the lateral ventricles exists also in the higher quadrumanes; and 3. that such is also the case with the pes hippocampi minor. Further that the two latter on the general testimony of human anatomists are variable and inconstant in man, so as really to be of little value as distinctive characteristics; and hence Huxley concludes that it may fairly be questioned whether the separation of man as a subclass from the other mammals is founded in fact. He admits,

however, that there still remain the following distinctions between the brains of men and monkeys: 1. In anthropoid apes the brain is smaller in proportion to the nerves having origin in it; 2. The cerebrum is smaller in proportion to the cerebellum, and 3. the gyrations of the hemispheres are shallower and more symmetric; while 4. in man the proportions of the various lobes to each other differ from those of corresponding lobes in the quadrumanes.

The first of these has been known since Sœmmering, the three others were established by the works of S. v. d. Kolk, Vrolik and Gratiolet. Sœmmering and Tiedemann are at variance as to the relative size of the nerves and the brain in the higher and lower races of men, but the latter considers the cerebellum to bear a larger proportion to the whole brain in the lower races. From the published dissection of the Hottentot Venus and the works of Gratiolet and Tiedemann, Huxley thinks the anterior development of the brain to be less in the lower races of men than is common with Europeans, and therefore that the differences between the European and bushman brains are of the same kind and degree as those between the bushman and orang brains. He wished that the surgeons at the Cape of Good Hope, India and Australia, would throw more light upon this interesting question by comparative dissections of the lowest races there, and concludes that as the brains of *Lemur mungos*, *Stenops tardigradus* and *Perodicticus*, differ so greatly from those of other monkeys, it is clear that the Quadrumana differ more among themselves in brain structure than some of them do from man, and that the separation of Homo and Pithecus in distinct subclasses while Pithecus and Cynocephalus are in one order is incompatible at least with the affinities of their brain structure.

M. Gratiolet's classic work, "Mémoire sur les plis cérébraux de l'homme et des primates" has so completely described the brains of the Quadrumana that their brain structure, at least as regards the external gyrations and lobes, is known better than that of any other group of animals. This work fairly surpasses all that has ever been done in this direction hitherto. M. Gratiolet has more recently (Comptes Rendus, 1860) investigated the brain structure of the gorilla, and has also given (Mémoires de la Société d'Anthropologie de Paris, 1860, tome 1, p. 64,) a comparative view of the brain development in man and monkeys. He says: "While this colossal ape, the gorilla, approaches man more nearly than any other ape in the strongly developed thumb and in the bones of the wrist, it rather approaches the Cynocephali in its brain and skull." More recently he has announced that by a study of the brain of the human microcephalus [idiot by arrest of development] and the development of the quadrumane brain, he is convinced that palpable anatomical differences are

evident. "I have found by a careful comparison of adult brains in men and monkeys, that they are arranged on the same plan as to the gyrations, and when the view is thus limited to the adult structure there is no marked ground for separating them. But in studying the development I find that in apes the gyrations of the posterior lobes appear before those of the anterior lobes which is just the reverse of their succession in man. In one the developement is from α to ω, in the other from ω to α, and hence it follows that no arrest of the development of a human brain can make it resemble that of an ape. This conclusion is borne out by a study of the brains of human microcephals. At first view one of them might be taken for the brain of a new species of ape, but the least observation corrects the error. In apes the fissura longitudinalis* is always long and deep; in the human microcephal, this fissure is always incomplete and often wanting, the sphenoid lobe being wholly smooth. Further, in the microcephal, the second connecting gyration (le deuxiéme pli de passage) between the occipital and parietal lobes which is a special characteristic of man is visible on the surface. In the orang brain on the contrary it is constantly concealed under the operculum of the posterior or occipital lobe. In its atrophied condition the microcephal brain, though it may be smaller and have fewer gyrations than the brain of an orang or chimpanzee, still shows its human character. The microcephal or idiot however low is no animal, he is only a reduced human being.

"I have endeavored to ascertain whether microcephalia precedes birth or not. In some microcephals the form of the brain and of the fissure of Sylvius showed the disease to be quite as early as the fifth month. Its cause is to be sought perhaps in some general influence, some primitive genetic weakness (Asthéniogénie) by which the abnormal form is produced. In the normal child at birth the gyrations of the brain are complete. This is also the case with the young of all animals that are born with open eyes, those that do not open their eyes till some time after birth do not complete the gyrations till then. If idiocy by arrest of growth took place after birth the completed brain would continue to show that completed structure, being infantine only in size. Such is not the case however. The abnormal condition occurs long before the curve of the brain is shortened and its growth ends also early, before the normal period of close. The enormous proportional development of the cerebellum in these little beings is interesting, for it is a proportion that puberty never attains. This fact is opposed to the theories of Gall in regard to the functions of the cerebellum, but on the other hand favors the views of Flourens. The microcephal usually moves

[* A fissure on the inner surface of the hemispheres just above the corpus callosum.]

with certainty, speed, and by an harmonious control of his muscular system. The strong relative development of the myelon or spinal cord is in conformity with these facts.

"The atrophy then in these creatures is confined almost entirely to the hemispheres of the brain. The organs of sense are large and well developed and the nerves which supply them have usually a proportional development far surpassing a normal one.

"I may remark here that as microcephals have the material and zoölogic marks of man, so have they also man's distinctive faculties. Most have a language, not rich it is true, but still articulate and distinct. Their brains in appearance below those of an orang or a gorilla, are still the habitation of a speaking soul. This innate, and as it were, inextinguishable quality, is man's highest and most distinctive feature; and however lowered by disease or imbecility, man is still human, not an ape.

"The microcephals wanting a part of their brain gyrations, are all small. I may mention in this connection the proportion that has been observed for some time between the complexity of the brain gyrations and the general size of the animal. It is true that all large animals have gyrations, whilst the greater proportion of small animals are destitute of them. Still I think the relation has not been justly conceived of. The presence of gyrations indicates not so much the great size of the individual [or its species], but rather that the whole zoologic group to which the individual belongs* consists essentially of large forms. Hence it is that the smallest species of those natural groups which include or consist mainly of gigantic forms have gyrations of some sort, as the weasel among the carnivores and *Antilopa hemprichiana* (Ehr.) and *A. spinigera* (Temm.) among the ruminants.

"Among human races the bushman brain has very simple gyrations and the anterior lobes have a simplicity never seen normally in white races. But bushmen are neither microcephals nor idiots. The very fact that this incomplete brain suffices for the functions of life shows that it is a normal and in one sense a specific condition, and that as related to man the bushmen are not degraded beings (êtres degradés). The race is fruitful. Its persistence amidst constantly adverse influences shows this. Every observation confirms the view that degraded forms of a species tend toward extinction.

Gratiolet concludes that "man is separated from the animals as completely by his physical organism as he is by his mental phenomena."

[Some very general remarks of Dr. Wagner are here omitted.]

[* It may be interesting to observe here that the hemispheres of the Capybara, the largest living rodent, have gyrations, contrary to the general rule among rodents.]

As regards the application of the brain structure to zoölogic classification, which I believe Leuret first,* and more recently Agassiz in regard to the turtles, suggested, the attempt of Owen among mammals shows its failure to be that of any other single anatomical character so used. As with the classification of fishes proposed by Müller and that by Agassiz, every application of a single organic character fails when carried out, leaving gaps that destroy the uniformity of the whole. It is the sum of the mutual relation of the individual parts of the structure that measures affinities, rather than individual marks of structure through the highest. The very objections, which Müller urges against Agassiz's classification by scales, may be applied with equal force to Müller's classification, based on the valves of the bulbus arteriosus.

There is much that suggests thought in Owen's application of the brain structure to classification. The importance of the organ leads one to expect beforehand that it should, better than any other individual character, mark the scale of the being. But the distinctions between morphologic and physiologic equivalents (analogies, homolgies, &c.), are still so indefinite and disputable as to demand the greatest caution; and though I accept, I must still regard them as obscure conceptions rather than as scientific facts.

In regard to the gyrations of the brain it seems surprising that so large, highly organized, and physically elevated an animal as the ostrich has smooth hemispheres like the lower mammals. Nor in man do the gyrations seem to hold a constant relation to the mind. The brain of the mineralogist, Hausmann, who had a body of more than ordinary size, appears to me similar to that of the Hottentot Venus or of a seventh month embryo. We do not know what relation the terminal gray substance of the surface may hold to the white fibres or to the nerve origins of the brain and spinal cord, nor their special psychical significance.

On the other hand the typical arrangement of the gyrations and the formation of the lobes of the cerebrum are certainly in intimate relation to the systematic division of the groups, orders and families. The ruminants, carnivores and quadrumanes give evidence of this, and the genera even may be known by their arrangement. But it is only the individuals of one order or family, and especially those of a marked natural group, that may be justly compared as to the relative development and arrangement, and in the number and details, of their gyrations.

[* Leuret's work bears date 1839; but Jourdan had before that, (*Comptes Rendus*, 1837.) read before the Academy a paper on a classification, adopted by him for the Museum of Lyons, based on the structure of the nervous system, and in the fall of the same year prince C. L. Bonaparte read before the Linnean Society of London a paper classifying the mammals according to the lobes of the brain, which principle he confessed he owed to Jourdan.—*Trans. Lin. Soc.*, xviii.]

So then we say that in a broad point of view man forms one group with the monkeys, in a narrower sense he forms a group by himself. And this from the structural arrangement of his brain and the configuration of its gyrations.

I do not understand how so much emphasis has been given to unessential parts that vary even among men; as the posterior horn of the lateral ventricle, the pes hippocampi minor and even the emminentiæ candicantes [corpora mammilaria] as distinctive of man. [Reference is here made to Serres' view, that the so-called corpora mammillaria of animals really represent the tuber cinereum.]

The plan and arrangement of the lobes* is one for man and the monkeys, and the fissures and the position of the various parts make a striking resemblance between even the lowest ape's brain and that of man.

Even if the difference of development pointed out by Gratiolet be given its utmost force, there is still a striking resemblance between the early stages of the human brain and the various grades of quadrumane brain structure. It is true the frontal lobes are peculiar by the early appearance of their gyrations, and yet between the smooth lobes of a fifth month human embryo and the smoothest hemispheres of the clawed quadrumanes, there is a marked resemblance. And so there is a similarity, in the few and symmetric gyrations of both hemispheres, and in the smaller and indistinct gyrations of the frontal lobes of the sixth or seventh month human fœtus, to many higher qudrumane brains; while the highest anthropoid apes are brought still nearer by the symmetry and number and depth of their gyrations, and by the presence even of the small gyrations in the insula Reilii. But they are always remarkably behind man in the overwhelming proportional development of his cerebrum to the whole brain and especially to the cerebellum, whilst essential differences occur as to the order, size and limits of the occipital lobes, for in the

[* The division of the brain into lobes as proposed by Gratiolet is as follows: The *central lobe* is the insula Reilii. The fissure of Sylvius running outward, upward and backward from this separates the *temporo-sphenoidal* or *temporal lobe* below, from the *frontal* and *parietal lobes* above, and finally terminates in the *external vertical fissure* of Gratiolet. This latter fissure passing outward and downward from the median line or inner surface of the hemispheres separates the *parietal lobe* above, and the *temporal lobe* below, from the *occipital lobe*. The ascending convolution in front of the fissure of Rolando separates the *parietal lobe*, in which it is included, from the *frontal lobe*. The continuation of the external vertical fissure on the mesial surface of the hemispheres is known as the *internal vertical fissure*. The *operculum* is the superior sharply defined edge of the occipital lobe, which partly overlies the *parietal* lobes in orangs. The *external vertical fissure* of Gratiolet appears to be rarely if ever filled up by connecting gyrations (plis de passage) in quadrumane brains, while in the mature human brain it is generally so filled. Owing to this it will be difficult perhaps to identify this fissure without a comparison of the brain of a seventh or eighth month fœtus. See further a summary of Gratiolet's work, *Ann. des Sci.*, 3me Série, t. xiv, p. 184, 1850.]

orang these lie lid-like [operculum] upon the gyrations that Gratiolet has called connection folds [plis de passage]. I may note here what Gratiolet has not mentioned, that the gyri breves of the insula Reilii are present in the orangs, and that, as I have elsewhere shown—"Vorstudien zu einer wissenschaftlichen Morphologie des Menschlichen Gehirns,"—the gyrations of the posterior lobes cannot be absolutely compared with those of man.

I however agree with Gratiolet, that there is no absolute identification of the human brain, not even of the microcephal, with the quadrumane brain. In a cast of a microcephalous brain, I find the occipital and parietal lobes quite small, the first indeed is almost wanting, so as to leave the cerebellum exposed. The cerebellum is however strongly developed. In the orang the occipital lobes are large and as is the case I believe in all brachycephalous and dolichocephalous races of men it completely overlaps the cerebellum. There is no closer approximation between the brains of men and monkeys than there is between their skulls. In the human microcephalus and the anthropoid apes, the brain pan (Schadelkapsel) is of a like size or even larger in the latter, the jaws project similarly, the arched line of the origin of the temporal muscle is higher and forms, even in the microcephal, a sort of crest or ridge, the proportions of the supra and inter maxilaries, the form of the nasals the canines (Eckzähne) and the chin are alike; but the whole shape, arrangement and connection of the facial bones of the microcephalus are yet so clearly human, that typical comparison separates them from the most anthropoid apes, and that on fundamental grounds. From all we know of the normal and abnormal human and ape structure, the two are separated as widely as birds and mammals, as monotremes (Schnabelthier) and ostriches or ducks since these show a superficial relation in bill, cloaca, and clavis. All I know of zoology and physiology is opposed to any such transmutation as Darwin suggests. Men and apes without any consideration of their mental phenomena are primitively and absolutely different in material structure.

[In a later number of the same Journal, Dr. Wagner makes some further observations upon the microcephalous brain, and sums up in the following interesting conclusions.]

1. In adult and strong microcephals the brain is less in weight and size than in a new-born child. This reduction of the brain mass is not however uniform in all its parts.

2. For while the cerebrum is less than that of a new-born child, the cerebellum is larger. The proportion of the cerebellum, corpora quadrigemina, medulla and pons varolii, to the cerebrum in well formed adults is as 1 to 7 or 8 in man, as 1 to 5 in orangs, as 1 to 3 or 4 in adult microcephals.

3. Further, while the four lobes of the cerebrum are stunted, the temporo-sphenoid lobe is least affected, the frontal next, and

the parietal and occipital lobes are most so. The central lobe—insula Reilü—with its gyrations appears to be wanting or very rudimentary in the lower microcephals as is also the operculum (Klappdeckel), while all of these are present in the orang.

4. Though the gyri are smaller, stunted or wanting, and the gray layer is thinner in the brains of microcephals, yet so far as the gyri are present they show the same relation and order as in the normal human brain. This normal arrangement, so far as I may judge from casts of the hollows of skulls and from a few dissections, is the same in type for all races of men.

5. The lateral ventricle appears relatively larger in the microcephal, and this shows that there is an early arrest of development, usually occurring in the third or fourth month, at which time the parietal and occipital lobes begin to grow, the central lobe is still rudimentary and the frontal and temporal lobes, especially the latter, have quite a development. The embryonal condition of some bones of the skull confirms this view. But this arrest is not so much arrest of growth as of development, the gyri and lobes increasing slowly in size and the atrophy or limitation being mostly shown in those parts that are undeveloped at the time of the arrest.

6. The resemblance to the brain of apes and particularly to that of the chimpanzee is only apparent, and consists mainly in the lesser size of the gyri and their consequent symmetry, while fundamental points, as the greater development of the occipital lobe, the posterior occipital fissure, &c., show distinctive ground plans for the two orders, Bimana and Quadrumana.

7. The condition of the bone tissue, the occasional asymmetry of the skull, the welding of the sutures, make it probable that in such cases a primitive disease of the bone tissue or rather of the whole nutritive system plays a part, as H. Müller has shown in fœtal rachitis.—(*Würburg Medic. Zeits.*, 1860.)

8. The anatomical condition of the microcephalous brain—see above—confirms the view that the cerebellum is not related to the intelligence but to the motor faculties. For whilst the intellect is extraordinarily wanting, the latter are hardly if at all deficient. It is true microcephals usually learn to walk late and have an uncertain or stumbling gait, but they are often quick and nimble in climbing. The complete integrity of the senses, especially of sight and hearing, favors the view that the transformation of sensations into perceptions, (Vorstellungen) takes place in the interior elements of the brain, in the basal part of the cerebrum, rather than in any part of the superficial layer which may exist in the frontal and temporal lobes.

The relation between the cerebrum and the intelligence is so express that we may say it is a certain amount of development of the former that is followed by the distinctive human

faculties.* The microcephals appear in this point of view to be below all mammals and birds. The more idiotic can only repeat like parrots some words they have often heard, and are not educable. When there is a certain amount of brain substance with a formation of the normal gyrations then it will depend upon education whether the higher intelligence manifests itself or not. It is however in a limited sense that we say the greater size of the cerebrum and richness of its gyrations run parallel with intelligence, though on the whole the brains of known great men stand generally at the top of the scale.

[It will be seen that Wagner, though always remarking that man is distinct from the Quadrumana, has not met the objections of Huxley; nor are we aware that Gratiolet has given any data for clearing up the apparent inconsistency in separating man as a sub-class, upon the structure of his brain, from the quadrumanes, while as great or greater differences exist among the genera of that order. But while it would be interesting to know how far the brains of the prosimiæ are essentially identical with those of the true simiæ, the formation of the sub-class, Archencephala, as coördinate to that of the Gyrencephala, does not seem to depend on such an identity. For man may be so separated on other grounds. On the distinction of mind, as is well known, he has already been removed by some zoologists to a separate sub-kingdom or even declared not to be the subject of zoologic classification. There being such strongly marked distinctions then, and these—the faculties of mind—being so closely related to the cerebrum as their organ, a uniform variation existing in this remarkably human organ would be sufficient, were there no other external distinctions, to characterize man from the most anthropoid apes or really from the whole of the Gyrencephala; though the same amount of variation could not be used for separating the genera of an order in which this organ and its function are not a characteristic feature.† Not that this organ is peculiar to man, but that it is emphasized in him, and that the high exercise of its function is one of his most marked traits. As such, a variation and especially a variation in the

* The following table of measurements of the brain given in another place is illustrative of this:

	Length.	Breadth.	Height.
Gauss the mineralogist,	185	141	125
Dutch,	168	131	125
Tunguse,	165	143	116
Russian,	167	131	120
Negro,	175	128	115
Microcephal aged 31 years,	102	66	71
" " 26 "	101	65	73
Old Orang Outang	101	108	87

The measurements are in millimetres.

[† Thus the interparietal has lost its irregular character as triquetral bones in the Rodents and become a very fixed trait in their skulls. The variation of this bone serving to mark genera in that order, while in man it varies from individual to individual.]

method of development, as shown by Gratiolet, is really of great force: granting however that if the distinctive faculties of mind did not follow this variation as a normal result, the mere variation in itself could not have such weight. Hence we think Huxley's objections are rather against the separation of man as *Archencephala*, than against the separation itself; and as such more specious than real, for it would be of equal force in logic to object against it that the ruminant or cetacean brain differs more from the quadrumane than that of man does from the chimpanzee's.

But the brain, however important in function, is really an obscure internal organ, and since there is so complete a relation between the external form and the mind even, some external feature would better have been chosen as characteristic of the sub-class. It has long been observed that man is more justly characterized by his great toe than by his thumb, by his foot than by his hand, since the former imply the erect attitude. When we see how the gradual elevation of the brain end of the body runs parallel with an elevation of zoologic grade as shown by C. G. Carus and others, we see one mark of high rank in this striking external trait. When we further consider that the locomotive function is performed by the spine and mesial fins in lower vertebrate forms is gradually shared by members not on the mesial line, and becomes more and more exclusively the work of these members, while the spine is successively shortened, until in man we have only the posterior pair of members applied to locomotion, we find another character of elevation in this posture. Carus has remarked that in using only one pair of members for locomotion, and leaving the other pair free to sensation and esthetic uses, man stands alone among animals. More recently Prof. Dana has mentioned the same idea to the writer, and has further emphasized it by observing that this application of members to the uses of the head in man is analogous to that cephalization which he has long ago shown to be a principal of elevation in the Crustacea.

To sum up then in regard to the order Bimana: the thumb and hands of the gorilla are far more powerful than those of man. But they are really organs of locomotion in these arboreal animals. Man alone has a foot with toe and heel that plants itself firmly, he alone stands erect among beasts, he alone having four well developed members uses only two for progression. With him the hand is an organ of sensation and belongs to the head, the central organ of the senses. This and all other marked features point to the human head as dominant over the whole body and to the subjection of all other functions to its functions of sensation, perception and thought.

These striking features are peculiar to man among the vertebrates, and thus on merely zoologic grounds he is clearly sepa-

rated from other mammals, and justly forms a sub-class by himself, even without regard to his mental phenomena—if it were posssible to conceive of their absence in such a structure.

The significance of the other sub-classes also is more evident, when we consider their size and organic development rather than their mere brain structure. Hence Prof. Dana has suggested to the writer the terms Macrencephala and Micrencephala for Gyrencephala and Lissencephala, the one being principally of large forms and the other—with the exception of the Edentata which however show a sluggish overgrowth—of corresponding small forms.

The Lyencephala would seem also to be better characterized by the short gestation and the premature birth of their young, than by the greater or less development of their corpus callosum; though such indications of an unfinished structure are interesting confirmations of their premature condition. It might also be objected that the term is too much like Lissencephala to be a really good one.

It is interesting to observe, in the phenomena presented by microcephals, that the typic development may be arrested, while a vegetative growth or mere increase in size may still continue in the part so arrested; indicating two kinds of forces, typic or formative, and nutritive. The former of these is essentially hereditary, governs the embryonic life and form, and gives rise more especially to the varieties of a species; the latter productive of growth and health is rather influenced by the conditions of life, food, &c.—W. C. M.]

New Haven, Aug., 1862.

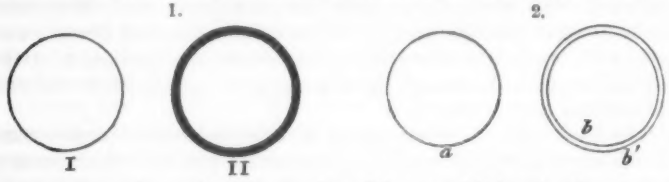
ART. XVIII.—*On some Stereoscopic Experiments;* by Professor O. N. ROOD, of Troy, N. Y.

1. *On the Binocular Combination of Drawings in fine and thick lines.*

SEVERAL years ago, Dove studied the curious effects produced by the stereoscopic union of linear drawings, in which the right and left hand projections were executed in different colors. Related to this, in a certain degree, is the case of the binocular union of drawings in the same color, but with the corresponding parts consisting of fine and thick lines.

I made in this manner, on a white ground, two projections of a convex pyramid; the lines of the right hand picture having three times the diameter of the corresponding lines of the left. Both sets of lines were black. In the stereoscope the relief was found to be but little impaired, although no proper fusion of the fine and thick lines had taken place: it was found, that the fine lines of the one projection combined with the edges

of the thick lines in the other, where the former remained plainly distinguishable. With another drawing, in which the thick lines were six times as broad as the fine, the latter still combined with the edges of the former, but the relief was obtained only with effort, or by excluding most of the light from the slide. With the second slide a certain amount of lustre is perceived.



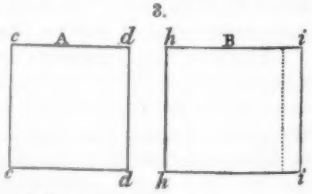
A very curious effect is produced by combining in the stereoscope two circles, such as I and II, the diameter of I corresponding to the inner diameter of II; the smaller circle is seen to lie in the plane of the paper, while the larger circle is considerably inclined to it.*

The analysis of this singular fact seems to be as follows: when we place in the stereoscope a slide such as that in fig. 2, the difference in the diameter in the circles being $\frac{1}{10}$ of an inch, combination alternately and rapidly takes place between *a* and (fig. 2) *b*, and between *a* and *b'*, the resultant impression being, according to the principles so ably developed by Prof. Wm. B. Rogers, that of two circles intersecting at a certain angle, the smaller one being situated in the plane of the paper.

Now, when the drawings are made in fine and thick lines, as in fig. 1, the fine line combines alternately with the exterior and with the inner edge of the thick line, and produces the same effect.

2. *On the Production of Lustre in the Binocular Combination of small and large Surfaces.*

By far the most valuable observations on the binocular combination of large and small drawings with which I am acquainted, are those made by Prof. William B. Rogers. The important distinction between the union of drawings differing in size in a horizontal or vertical direction, was first pointed out by him, as well as the fact, that while the former case is normal and of daily occurrence, the latter takes place to a much smaller degree, if at all. Thus he showed that two such parallelograms as A and B in fig. 3 combined readily, and that the resultant image made a considerable angle with the plane of the paper.



* Persons unpracticed in binocular combination will obtain the effect only after several trials.

I combined two such black surfaces as A and B (fig. 3); the ground was white. Now it is evident that when the edges *c c* and *h h* coincide, *d d* cannot coalesce with *i i*, consequently the narrow band, included by the dotted line, appears white to one eye and black to the other; in spite of this, however, the play of the ocular axes was so rapid, and the two combinations so quickly effected, that no lustre on this band was perceptible. Similar experiments with yellow squares on a blue ground gave a like result. When, however, the inequality was in a *vertical* direction, the unmatched band or edge showed lustre with distinctness.

As Dove* has pointed out that the stereoscopic experiments published by me in this Journal† still further confirm his position in opposition to some distinguished physicists, that lustre does not necessarily depend upon an idea of solidity or depth, I will here mention two additional experiments, which would seem to remove the last shadow of doubt on this point. I combined in the stereoscope black surfaces ½ inch square with various tinted papers 1½ inches square, when lustre resulted, although the two figures totally refused to unite into one. Finally, a piece of red or white paper, 1 inch square, was pasted on one side of a blackened stereoscopic slide, which was then placed in the stereoscope. Here but *one figure* was present; to the other eye merely a dark field was presented; consequently, the difficulty of uniting two stereoscopic pictures was not present. After a little trial brilliant lustre was produced, as in the former case. This experiment is somewhat more difficult to make than those previously described by Dove and myself, simply because it is here not quite so easy to divide the attention equally between the two eyes. The lustre then is independent of the idea of depth, and *two* figures are useful merely in enabling the observer the more readily to pay equal attention to the two impressions. The following experiment points to the same conclusion.

3. *Production of Lustre by the convergence of the Ocular Axes.*

In the following beautiful experiment the idea of solidity is not only excluded, but the lustre is seen detatched even from a material surface. An aperture, ½ inch in diameter, is cut in a blackened piece of cardboard, and across the opening a sewing-needle is fastened by a little wax. The card thus prepared is held at a distance of six or eight inches from the eyes, while behind it, at a distance of a foot or more, a sheet of white paper is placed beside one which is blackened. The cardboard is held in such a manner that the aperture appears black to one eye and white to the other; the ocular axes are then converged on the

* Pogg. Annalen, vol. cxiv, p. 165. † Vol. xxxi, May, 1861.

needle, which is attentively regarded. The open aperture now assumes a lustrous appearance, and one is tempted to believe that it encloses a plate of very clear polished glass; but as an instinctive search for minute particles of dust on this imaginary surface fails to detect them, the idea is gradually forced on the mind that it is the *air* itself which now has become lustrous. By shading the black paper the effect is much heightened. Corresponding effects are produced by the use of blue with yellow paper, etc.

Dove suggests,* that the peculiar lustre of the deep blue sky is caused by light from different distances falling on the eye; and I found, in fact, in this experiment, that when a surface of dark blue paper is combined with white or light blue paper, the combination strongly reminded me of the soft lustre of a cloudless sky.

Troy, N. Y., August, 1862.

ART. XIX.—*Tenth Supplement to Dana's Mineralogy;* by GEO. J. BRUSH, Professor of Metallurgy in Yale College.

List of Works, etc.

A. KENNGOTT: Uebersicht der Resultate mineralogischer Forschungen im Jahre 1860. 8vo, pp. 217. Leipzig, 1862.

H. KOPP UND H. WILL: Jahresbericht über die Fortschritte der Chemie, und verwandter Theile anderer Wissenschaften. 8vo, pp. 906. Giessen, 1861.

H. GIRARD: Handbuch der Mineralogie. 8vo, pp. 656. Leipzig, 1862.

F. v. KOBELL: Die Mineralogie—Populäre Vorträge. Frankfurt a. M. 1862.

H. O. LENZ: Mineralogie der alten Griechen und Römer. 8vo, pp. 194. Gotha, 1861.

FRIEDERICH HESSENBERG: Mineralogische Notizen, No. 4. Dritte Fortsetzung. 4to, 44 pp. Frankfurt, 1861. This number of Hessenberg's "Notizen" contains figures and descriptions of crystals of Gypsum from Girgenti; Calcite from Bleiberg, Maderaner-Thal and Ahrnthal; Apatite, Sphene and Perowskite from Pfitsch in Tyrol; American Chrysoberyl; Datholite from Bergen Hill; Haytorite; Fahlerz from Kuhl; Barytes from Ober Ostern; Brucite from Texas, Pennsylvania; Orthoclase from Baveno.

A. SCHRAUF: Monographie des Columbit. 8vo, pp. 20, mit 7 Tafeln. Wien, 1861.

H. DAUBER: Ermittelung Krystallographischer Constanten, und des Grades ihrer Zuverlässigkeit (22. Rothbleierz). 8vo, pp. 53, mit 12 Tafeln. Wien, 1860.

PETERS K. F.: Mineralogische Notizen. I. Ein Beitrag zur Entwicklungs-Geschichte des Azurits und des Malachites von Moldava im Banat. II. Ueber Kalcit und die rhomboedrischen Karbonspathe im Allgemeinen. III. Miscellaneen—Neues Jahrbuch für Mineralogie, etc., Jahrgang, 1861, pp. 278–285, 434–458, 655–666.

——— Geologische und Mineralogische Studien aus dem südöstlichen Ungarn, insbesondere aus der Umgegend von Retzbanya. Sitzungsberichte der Wien. Akad. der Wissenschaften, xliii, 385–463, xliv, 81–187.

H. SAINTE CLAIRE DEVILLE: De la présence du Vanadium dans un minerai alumineux du midi de la France. Etudes analytiques sur les matières alumineuses. Ann. de Chimie et de Physique, (3,) lxi, 309.

* Pogg. Annalen, vol. cxiv, p. 167.

H. Sainte Claire Deville: Observations sur la présence de quelques éléments ordinairement tèrsrares dans des substances plus communes. Ann. de Chimie et de Physique, (3), lxi, 342.

——— Du mode de formation de la Topaze et du Zircon. Compt. Rendus, lii, 780.

——— De la production de la Willémite et de quelques Silicates métalliques. Comptes Rendus, lii, 1304.

——— Reproduction de Fer oxydulé, de la Martite, et de la Périclase—Protoxyde de Manganése cristallisé. Comptes Rendus, liii, 199.

H. St. Claire Deville et Troost: De la reproduction des Sulfures métalliques de la nature. Comptes Rendus, lii, 920.

A. Daubrée: Observations sur les Zéolithes formées dans un béton romain par les Eaux thermales de Luxeuil (Haute-Saône). Bull. Soc. Geol., xviii, 108.

——— Betrachtungen und Versuche über den Metamorphismus und über die Bildung der krystallinischen Gesteine. Aus dem xvii. Bande der Mémoires présenté par divers savants a l'Académie des Sciences. Paris, 1860, übersetzt von E. Söchting, Berlin, 1861.

A. Des Cloizeaux: Memoire sur un nouveau Procédé propre à mesurer l'Indice moyen et l'Ecartement des Axes optiques dans certaines substances où cet écartement est très-grand, et sur la Séparation de plusieurs Espèces minérales regardées jus'qu' ici comme isomorphes. Comptes Rendus, lii, 784.

——— Sur les Modifications temporaires et sur une Modification permanente que l'Action de la Chaleur apporte à quelques propriétés optiques du Feldspath orthose. Comptes Rendus, liii, 64.

——— Notice sur les Travaux minéralogiques et géologiques. 4to, pp. 37. Paris, 1861.

A. Delesse: De l'Azote et des Matières organiques dans l'Ecorce terrestre. 8vo, pp. 176. Paris, 1861.

——— Etudes sur le Métamorphisme des Roches. 4to, pp. 95. Paris, 1861.

E. Hitchcock, E. Hitchcock, Jr., C. H. Hitchcock and A. D. Hager: Geology of Vermont. 4to, pp. 988. Claremont, 1861.

J. D. Whitney: Report of a Geological Survey of the Lead Region of the Upper Mississippi. Extracted from the First Volume of the Geological Survey of Wisconsin, pp. 73–424. Albany, N. Y., 1862.

E. Holmes and Charles H. Hitchcock: General Reports on the Geology and Natural History of Maine; comprises 360 pages of the Sixth Annual Report of the Maine Board of Agriculture. 8vo, pp. 464. Augusta, 1861.

A. Winchell: First biennial Report of the progress of the Geological Survey of Michigan, embracing observations on the Geology, Zoölogy and Botany of the Lower Peninsula. 8vo, pp. 339. Lansing, 1861.

Description of Species.

Adamsite.—See Margarodite.

Algodonite [Suppl. V].—Dr. Genth has identified this mineral as occurring with *whitneyite* from Lake Superior (see whitneyite). It is more granular than the associated whitneyite; it has a grayish-white color and metallic lustre, and when polished is almost silver white. The purest of it forms the lining of little cavities as minute crystals, too indistinct to determine their form. Analysis shows that the composition is very nearly that of *algodonite*, although a slight admixture of whitneyite generally gives the arsenic a little too low. Dr. Genth has also analyzed a specimen of algodonite from Cerro de los Seguas (Dept. Rancagua, Chile). The Chile mineral had a density of 7·62; hardness, about that of fluor; color, steel-gray to silver white; fracture, sub conchoidal; brittle; lustre, on fresh fracture, metallic but becoming dull on exposure; associated with cuprite, barytes, malachite, etc. Analysis of the mineral from the two localities gave:

	As	Cu	Ag		
1. Lake Superior,	15·30	84·22	0·32	=	99.84
2. "	undet.	84·10	0·34		
3. "	16·72	82·35	0·30	=	99·37
4. Chile,	17·46	81·82	*tr.*	=	99·28
5. "	16·94	82·33	*tr.*	=	99·27
6. "	16·44	83·11	*tr.*	=	99·55

Nos. 1 and 2 appear to have contained a small admixture of whitneyite. Nos. 3, 5 and 6 give almost exactly the formula $Cu_{12}As$=As 16·50, Cu 83·50—(this Journal, xxxiii, 192).

ALISONITE [Suppl. VII].—F. Field gives a new analysis of this species, in which he found:

S	Cu	Pb		
17·69	53·28	28·81	=	99·78

This agrees very closely with the former analysis, and gives the formula 3CuS+PbS=S 17·78, Cu 53·34, Pb 28·88.—(*Quar. Jour. Chem. Soc.*, xiv, 160.)

ALLANITE [p. 208, I—VI, VIII].—D. M. Balch has found *orthite*, associated with quartz and feldspar, at Swampscot, Mass. It is massive; color, jet black; streak, gray; G.=3·69–3·71 at 18° C. B.B. fuses to a black blistered glass; with borax and soda gives reactions for iron and manganese. Composition:

Si	Al	Fe	Ce	Y	Ca	Mg	Na	H	
1. 33·31	14·73	15·82	21·94	1·32	7·85	1·25	undet.	1·49	=97·71
	Al Fe								
2. 32·94	33·60		20·71	1·32	7·87	1·47	"	1·49	=99·40

The mineral in its natural state is decomposed by chlorhydric acid, but after ignition is not affected by it. It very nearly corresponds in composition with the orthite from Hitteroe—(this Journal, [2], xxxiii, 350).

Analysis of *allanite* from Franklin, New Jersey, by T. S. Hunt (Proc. Bost. Soc. Nat. Hist., viii, 57). The mineral is associated with feldspar, and was found by Dr. Jackson, in the old Magnetic Iron Mine at Franklin. Sp. Gr.=3·84. Partially decomposed by hot chlorhydric acid, with separation of flocculent silica. Composition:

Si	Al	Fe	Ce	La Di	Ca	Mg	Mn	Ign.
30·20	13·05	18·25	16·60	6·90	11·76	1·70	*tr.*	1·30

ALUNITE [p. 388, V].—Analyses of native *alunite*, from Talfa, Italy, and Muzsai, Hungary, by A. Mitscherlich.—(*Jour. pr. Chem.*, lxxxiii, 464.)

	Al	S	Ca	Ba	K	Na	H
Tolfa,	36·83	38·63	0·70	0·29	8·99	1·84	12·72
Muzsai,	39·15	36·93	0·49	0·19	10·67	—	12·57

Mitscherlich considers that the rational composition is best expressed by the formula $\dot{K}\dot{S}+\ddot{Al}\dot{S}^3+2\ddot{Al}\dot{H}^3$, as the water is not expelled below the temperature of boiling sulphur, and moreover, when expelled, the residue consists of anhydrous alum and alumina.

ANGLESITE [p. 370, II, III].—F. Field has examined a black amorphous variety of sulphate of lead, from a mine near Coquimbo, Chile. It occurred in large black masses, in the centre of which a small vein of galena was running. It had a black earthy appearance, and was without metallic lustre. The argentiferous galena forming the nucleus of the mass, contained appreciably more silver than the exterior sulphate. G.=6·20. Composition:

Pb $\dot{S}$	Fe	Ag		
96·74	3·16	*tr.*	=	99·90

(*Quar. Jour. Chem. Soc.*, xiv, 156.)

Antozonite.—See FLUOR.

APHROSIDERITE [p. 297, I].—Erlenmeyer gives analyses of a mineral resembling *aphrosiderite*, from two iron mines; one at Muttershausen, in Nassau, the other at Balduinstein. The streak of the mineral from both localities is apple-green.

	$\dot{S}i$	$\dot{A}l$	$\dot{F}e$	Fe	$\dot{M}g$	$\dot{H}$	
1. Muttershausen, G.=2·99	25·72	20·69	4·01	27·79	11·70	10·05	=99·96
2. Balduinstein, G.=3·01	25·99	——	4·13	27·60	11·93	10·13	

Corresponding very closely with the *aphrosiderite* analyzed by v. Hauer, from Upper Styria (Supp. I).—(Kopp's *Jahresbericht*, 1860, 773.)

APOPHYLLITE [p. 304, V].—Analysis of the pink *apophyllite*, from Andreasberg, by H. Stölting:

$\dot{S}i$	$\dot{C}a$	$\dot{K}$	$\dot{H}$		
51·73	25·02	5·10	15·73	=	99·58

No fluorine is given.—(*B. and H. Zeitung*, xx, 267.)

ARSENICAL-ANTIMONY [p. 22].—An interesting variety of this mineral, from the Ophir Mine, Nevada Territory, has been described and analyzed by F. A. Genth. Occurs in reniform, finely crystallized, somewhat radiated masses. Color on fresh fracture between tin-white and iron-black, but grayish-black on exposure. Composition, after excluding impurities, As 90·82, Sb 9·18—(this Journal, [2], xxxiii, 190).

ARSENOLITE [p. 139.].—Dr. Genth has found *arsenolite*, associated with arsenical-antimony, in specimens, from the Ophir Mine, Nevada Territory—(this Journal, [2], xxxiii, 190).

Automolite.—See SPINEL.

BIHARITE [*K. F. Peters Ber. Wien. Akad.* xliv, 133].—Peters gives this name to a mineral from Werksthal near Retzbanya, which has previously passed under the name of *agalmatolite*. It is a massive, compact micro-crystalline substance associated with fine granular limestone. The mass has a greasy feel and adheres somewhat to the tongue. It is slightly brittle, fracture uneven to splintery conchoidal. H.=2·5. G.=2·737 (yellow variety). Color yellow and green—from brown and cloudy wine-yellow to leek green. Small splinters are transparent, all varieties translucent. Streak white. Lustre, greasy to pearly, with polarization microscope shows double refraction. Rubbed with silk gives positive electricity. B.B. in closed tube yields water and becomes white or grayish white. The green variety is infusible, and the yellow variety fuses only on the edges. With cobalt solution gives first a rose-red, and after longer heating, a violet color. Does not gelatinize with acids. A specimen of an apparently homogeneous variety of a wine-yellow to oil green color analyzed by M. Soltesz gave,

$\dot{S}i$	$\dot{A}l$	$\dot{F}e$	$\dot{C}a$	$\dot{M}g$	$\dot{K}$	$\dot{N}a$	$\dot{H}$	$\dot{C}$	
39·80	12·83	*tr.*	6·68	27·49	4·63	*tr.*	4·24	2·05	=97·72

The carbonic acid was due to limestone mechanically mixed with the mineral. Peters remarks that, he "is far from considering this silicate as a well characterized mineral." To establish this point, he says "that it would be first necessary to have analyses of all the different varieties, still in order to induce further investigation, he names it *biharite*, after the mountain in which it occurs." We feel justified in remarking, that if the mineral is not "well characterized," the author is somewhat premature in giving it a new name. We question very much the propriety of adding a new name to science, without full and just grounds, under the plea of inducing further investigation. It is gaining the credit of naming a species, while throwing the burden of investigation on others.

BISMUTH [p. 20, VIII].—A remarkable vein, containing metallic bismuth, has been opened at the Atlas Mine, in Devonshire. The vein is three feet in width, and the bismuth constitutes one-sixteenth of the whole mass, having a value of £300 to the fathom.—(*Dingler's Polytechnisches Journal*, clix, 76.)

BORACITE [p. II, III–VIII].—Analysis of stasfurthite, by Kromayer (Ludwig, in

Kopp's *Jahresbericht*, 1859, 816). The mineral was washed with cold water, to free it from adhering chlorid of magnesium. The insoluble portion gave:

Mg Cl	Ṁg	Ḣ	B̈[a]
9·97	24·93	6·20	58·90

[a] By difference.

giving the formula $2(\dot{M}g^3\ddot{B}^4+\dot{H})+MgCl,\dot{H}$ or two equivalents more of water than obtained by Heintz and Potyka.

Boronatrocalcite [see Hayesine, p. 394, V, VIII].—H. How has given the name *cryptomorphite* to a hydrous borate of lime and soda, which is found in gypsum, near Windsor, Nova Scotia (this Journal, [2], xxxii, 9). It occurs in cakes, or rounded masses, of the size of a small pea or bean, laying between crystals of glauber salt and gypsum. Color, white; lustreless; soft, H.=1, but coherent; tasteless; slightly tough between the teeth. B.B. fuses easily to a clear bead; insoluble in water; soluble in chlorhydric acid. On exposure to the air, loses 18·36 per cent of water. With a magnifying power of 350 diameters, Prof. Robb found the mineral to be distinctly crystalline, with a rhombic structure, and differing in form very materially from the natro-borocalcite found at the same locality. Composition of the air-dried mineral:

Ċa	Ṅa	S̈	Ṁg	Ḣ	B̈
14·21	7·25	3·98	0·62	19·96	53·98

Assuming the magnesia and sulphuric acid to be accidental, and deducting the magnesia as $\dot{M}g\,\ddot{S}+7\dot{H}$, and the remaining sulphuric acid as $\dot{N}a\,\ddot{S}$, How obtains Ċa 15·55, Ṅa 5·61, Ḣ 19·72, B̈ 59·10, corresponding to the formula $\dot{N}a,3\dot{C}a,9\ddot{B}+12\dot{H}$, or $\dot{N}a\ddot{B}^4+\dot{C}a^3\ddot{B}^5+12$ aq. [We have placed this mineral under *boronatrocalcite*, as, according to our view, this name expresses sufficiently well its composition and relations in the classification of hydrous borates. If we were to calculate formulæ for all of the published analyses of hydrous borates of lime and soda, we should have at least a dozen different compounds represented. No one believes that these are all distinct mineral species, and until repeated analyses are made, which prove the definite and invariable composition of the mineral from any given locality, we may well hesitate before creating or adopting any more new species. The hydrous borates of lime and soda have already rather an excess of synonyms; for the lime borate we have hayesine, borocalcite and hydroborocalcite; for the lime and soda borate: boronatrocalcite, ulexite, tinkalzite, tiza, natroborocalcite, and now cryptomorphite. That there are two distinct species, hayesine and boronatrocalcite, does not admit of a doubt, but as the composition of neither of these is definitely settled, we are not yet willing to admit that these names, as at present applied, each represent three or four distinct mineral species.—G. J. B.]

Bournonite [p. 80, V].—F. Field has found this species at a mine near Huasco, in northern Chile. The specimen was crystallized. H.=2·5, G.=5·80. It resembled in every respect the *bournonite* from Cornwall. Field gives analyses of both the Chilean and Cornish minerals, with the following results:

	S	Sb	Pb	Cu	
Huasco,	20·45	26·21	40·76	12·52	= 99·94
Cornwall,	20·30	26·30	40·80	12·70	= 100·10

These analyses correspond in a most remarkable manner with Rose's analysis of the Pfaffenberg *bournonite*.—(*Quar. Jour. Chem. Soc.*, xiv, 158.)

Brucite [p. 133, I, II–IX].—R. Hermann has given the name *Texalite* to the hydrate of magnesia from Texas, Pennsylvania, and has attempted to show that its form was monoclinic, and that $\dot{M}g\dot{H}$ was consequently dimorphous (*Jour. für prakt. Chem.*, lxxxii, 368). The writer has already proved, from the examination of a large number of crystals, that this conclusion was erroneous (this Journal, xxxii, 94), and that the form of the Texas mineral is rhombohedral, as already determined by Dana, and, previous to the publication of Hermann's paper, it had also been determined by Kenngott and G. Rose (*Zeitschrift der Geol. Gesellschaft*, xiii, 178). The paper by Rose had not then been received here, or it would have been quoted in answer to Hermann. The crystals examined by Rose and myself were hexagonal

prisms, with rhombohedral planes R and $-\frac{1}{2}R$. Since the publication of these results, Hessenberg has published, in No. 4 of his "Notizen," an examination of the crystalline form of this species, which also shows it to be rhombohedral. To this we may add, that Dr. Auerbach found that its optical properties were those of a rhombohedral substance, an observation which we are able to substantiate.

With such an accumulation of facts from five different authorities, it may safely be assumed that texalite does not differ from ordinary rhombohedral *brucite*.

An analysis of the Texas mineral gave Hermann:

Mg	Mn	H
68·87	0·80	30·33

Calamine [p. 313, II–VII].—The name *wagite* has been given by Radoszkovski, to a concretionary silicate of zinc from Nijni-Jagurt, in the Ural (*Comptes Rendus*, liii, 107). It occurs in concretionary crusts, which, when examined by the magnifier, show indistinct crystals. Color, light blue to green. H.=5, Sp. gr.=2·707. Soluble in acids. Composition:

	Si	Ca	Zn	H	Cu Fe	
	26·00	1·55	66·90	4·70	*tr.*	= 99·15
Oxygen,	13·87	·44	13·21	4·18		

giving the ratio for Si, Zn, H. 3 : 3 : 1½. The author, by an error in calculation makes the ratio 3 : 3 : 1; the composition and ratio are so near those of Calamine, that for the present we may safely consider wagite a variety of this species. The, only anomalous property is the specific gravity, which is considerably less than that given for Calamine.

Cancrinite [233, II–VIII].—G. Tschermak has examined *cancrinite*, from Ditro in Siebenbürgen. It is found in loose masses, with sodalite, elæolite and orthoclase. Color, pale flesh-red; cleaves perfectly, yielding hexagonal prisms. H.=5–5·5, G.=2·42. Composition:

Si	Al	Ca	Na	H	C	
37·2	30·3	5·1	17·4	4·0	5·2	= 99·2

not differing materially from the composition of cancrinite from the Ural and from Maine.—(*Ber. Wien. Akad.*, xliv, 134.)

Cervantite [p. 141].—T. L. Phipson has examined a native oxyd of antimony from Borneo, which is identical with this species (*Comptes Rendus*, lii, 752). It is associated with stibnite, and occurs as a compact crystalline substance, of a yellowish or reddish-white color and yellowish white streak.

Isolated crystals, of half an inch in length, were also found, having the form of the right-rhomboidal prism, terminated by two planes with modifications; they had a pearly lustre, and were horizontally striated. In the closed tube, the mineral was non-volatile and unaltered, thus distinguishing it from SbO_3. B.B. infusible, thus differing from SbO_5. Pure specimens were entirely volatile in the reducing flame, but unaltered in the oxydizing flame. These reactions, in connexion with the following analysis, show the mineral to be SbO_4. With soda gives metallic antimony. The specimen analysed contained stibnite, sulphur, oxyd of iron and alumina as impurities. Composition:

	SbO_4	H	Fe Al	Si, S, etc.	
G.=4·64–4·68	65·00	3·75	10·00	21·25	= 100·00

[Phipson considers the water as combined with the antimony, giving the formula SbO_4, HO, and refers the mineral to Beudant's species *stibiconite*, but as we infer from his description that the pure mineral was unaltered in the closed tube, we may assume that the water was combined with the iron, alumina, and other impurities mentioned.—G. J. B.]

Chabazite [p. 319, II].—Analysis of *chabazite* from Oberstein gave G. Schrœder:

Si	Al	Ca	Ba	Sr	Na	K	Mg	H	
50·19	17·45	7·13	0·48	0·32	2·12	0·62	*tr.*	22·09	=100·40

—Kenngott, *Uebersicht*, 1860, 56.

CHLORITE [p. 294, IV, V–VIII,].—Genth has described a chlorite-like mineral from Webster, N. C., which he considers a result of the alteration of chrysolite. It occurs in what appear to be rhombohedral plates, and the crystals, though indistinct, present triangular basal and rhombohedral planes. Cleavage, basal and highly perfect. H=2·5. Color, dark bluish to brownish-green; translucent. B.B. exfoliates slightly and becomes silver-white. Infusible. The material for analysis was too small to have it of uniform color.

	$\dot{S}i$	$\dot{A}l$	$\dot{C}r$	$\dot{F}e$	$\dot{N}i$	$\dot{M}g$	$\dot{C}a$	$\dot{K}$	Ign.
1.	31·15	13·70	4·16	4·83	0·16	undet.	0·17	undet.	3·29
2.	31·75	12·45	undet.	4·94	undet.	43·10	undet.	0·06	undet.
Mean,	31·45	13·08	4.16	4·88	0·16	43·10	0·17	0·06	3·29=100·35

These results place the mineral near pyrosclerite and chlorite. The small amount of water is remarkable, especially when taken in connection with the anhydrous talc from the same locality—(this Journal, [2], xxxiii, 200).

Shepard's *rastolyte*, from Monroe, New York, is shown by Pisani to be a *ferruginous chlorite* (*Comptes Rendus*, liv, 468). Pisani observes, that although the mineral is somewhat acted upon, it is not entirely decomposed by acids. After deduction of the iron pyrites with which it is intimately associated, the composition was found to be:

$\dot{S}i$	$\dot{A}l$	$\dot{F}e$	$\dot{M}g$	$\dot{H}$		
34·98	21·88	28·44	6·24	9·22	=	100·76

All the iron was in the state of protoxyd. A former analysis by Shepard made the composition near that of stilpnomelane (see Suppl. IV); but this analysis is undoubtedly incorrect, as Pisani has proved that the mineral is only partially decomposed by acid, so that results obtained from an attempted decomposition by acids must be erroneous. The physical properties and chemical composition of the mineral render it extremely probable that it is an impure variety of chlorite.

CHRYSOCOLLA [p. 309, II–VIII].—F. Field has published an interesting paper on the silicates of copper from Chile (*L. E. D. Phil. Mag.*, [4.] xxii, 361). A variety from Tambillos, near Coquimbo, having a turquoise-blue color, perfectly amorphous and opaque, gave on analysis: $\dot{S}i$ 28·21, $\dot{C}u$ 39·50, $\dot{H}$ 24·52, $\dot{F}e$ 2·80, $\dot{A}l$ 4·97. Excluding the iron and alumina, as foreign to the mineral, we have $\dot{S}i$ 30·59, $\dot{C}u$ 42·83, $\dot{H}$ 26·58 or $\dot{C}u\,\dot{S}i+3\dot{H}$. Other analyses are given of substances which do not appear to be definite compounds.

CHRYSOLITE [p. 184, I–IV, VI].—F. A. Genth has analyzed two varieties of *chrysolite*, occurring in talc-slate, at Webster, Jackson Co., N. Carolina: 1. pale grayish-green, granular and very friable, G=3·28 (12° C); 2, less friable, of darker yellowish olive-green color, G.=32·52.

	$\dot{S}i$	$\dot{F}e$	$\dot{N}i$	$\dot{M}g$	$\dot{C}a$	Chrome-iron and quartz.	Ign.
1.	41·89	7·39	0·35	49·13	0·06	0·58	0·82=100·21
2. (*a*,)	40·37	7·39	0·50	——	——	1·27	0·50
2. (*b*,)	40·74	7·26	0·39	49·18	0·02	1·83	0·76=100·18

with traces of alumina, oxyds, of cobalt and manganese, associated with chrome-iron, talc, serpentine, and a mineral resembling pyrosclerite. Dr. Genth expresses the opinion, that the specimens give evidence that chrysolite is probably the mineral from which talc-slate, and many of the serpentines have been formed—(this Journal, [2], xxxiii, 199).

For analysis of altered olivine from Ihringen, in Breisgau, by Lewinstein, see Kopp, *Jahresbericht*, 1860, 757.

CLINOCHLORE [p. 293, I, II, V–IX].—Analysis of *clinochlore* from Achmatowsk, by H. Struve:

$\dot{S}i$	$\dot{A}l$	$\dot{F}e$	$\dot{M}g$	$\dot{C}a$	$\dot{H}$		
31·64	13·54	5·83	36·20	0·05	12·74	=	100
31·52	13·96	6·12	35·68	0·05	12·67	=	100

Mat. Min. Russlands, iii, 236, in Kopp's *Jahresbericht*, 1860, 772.

COPIAPITE [p. 387, I, III, IV].—A new analysis of *fibroferrite*, from Chile, by F. Field, (*Quar. Jour. Chem. Soc.*, xiv, 156,) shows that this mineral loses water on exposure to the air. The mineral is found in botryoidal masses, each rounded nodule being built up of innumerable silky fibres diverging from a centre, and having a golden green color. An analysis gave the formula $\dot{F}e\,\ddot{S}^2+10\dot{H}$. On exposure to the air for two weeks it lost two equivalents of water; a longer exposure of many months produced no further change in composition. Heated at 212° F. it was converted into $\dot{F}e\,\ddot{S}^2+3\dot{H}$.

COPPER [p. 17, IV, VI-IX].—The pseudomorphous crystals of copper after aragonite, described by Kenngott (Suppl. V), have been examined by D. Forbes, (*Quar. Jour. Geol. Soc.*, London, xvii, 45). Crystals are found in the copper mines of Corcoro, in Peru. They are hexagonal; some consist entirely of copper, while others have a nucleus of carbonate of lime, from which Forbes infers that the pseudomorphs have been formed by the action of a solution of copper on crystals of carbonate of lime, and by some subsequent chemical change the carbonate of copper thus formed has been reduced to the metallic state. An analysis of one of the crystals, by Kroeber, gave:

Cu	Si	Ag	Fe*	Insol.		
98·605	0·015	*tr.*	1·376	0·004	=	100·00

* By difference.

F. Alger has described what he considers to be a rhombohedron of copper, from Copper Falls Mine, (Lake Superior). It is associated with rhombohedral carbonate of lime, and the copper is thought by Alger to be pseudomorphous of calcite. Dr. Jackson suggests that the crystal may be a cube, which slightly distorted, gives it a rhombohedral aspect (*Proc. Bost. Soc. Nat. Hist.*, viii, 171).

COPPER GLANCE [p. 46, 505].—Dr. Genth has made a very elaborate series of analyses of the so-called *harrisite*, from the East Tennessee Mine, Polk Co., Tenn., which entirely substantiate his former opinion, that "harrisite was copper-glance pseudomorphous after galena." Dr. Genth mentions that Dr. Torrey first discovered specimens of *harrisite* from Canton Mine, which contained a nucleus of *unaltered galena*, and soon after Mr. Trippel, of the Tennessee Copper Mines, discovered this same pseudomorph at the East Tennessee Mine, at which latter place it is found in a feldspathic rock, associated with chalcopyrite, pyrites, blende, garnet and lime-epidote. The Tennessee specimens have a color between dark lead gray and bluish black. They frequently contain a nucleus of almost unaltered galena; some specimens are almost pure copper-glance, while others are intermediate between copper-glance and galena, as shown by the analyses. The rational composition deduced from the analyses of seven specimens gave the following:

	1.	2.	3.	4.	5.	6.	7.
Galena,	97·41	26·93	14·50	13·14	3·29	1·24	0·47
Silver-glance,	0·83	0·24	0·57	0·83	1·26	0·23	0·18
Covelline,	1·41	——	5·02	4·11	4·70	2·20	9·03
Copper-glance,	——	70·26	78·82	81·05	89·89	93·80	80·70
Pyrites,	0·43	3·20	1·09	0·86	0·86	1·39	8·81

Analysis 2 by Trippel, the others by Genth. The author queries whether alisonite, $3Cu_2S+PbS$, and cuproplumbite $Cu_2S+2PbS$ may not also prove to be pseudomorphs of copper-glance after galena in an unfinished condition—(this Journal, [2], xxxiii, 194).

COPPER-NICKEL [p. 52, VI-VIII].—Analysis of *copper-nickel* from Andreasberg by H. Hahn (*B. and H. Zeitung*, xx, 281):

Ni	Co	As	S	Fe	Insol.		
23·75	10·81	50·94	5·69	0·83	8·80	=	100·82

Cryptomorphite.—See BORONATROCALCITE.

DATHOLITE [p. 334, I-IV, VI, VIII].—G. Tschermak has analyzed the transparent crystallized *datholite*, from Toggiana. He found $\ddot{S}i$ 38·2, Ca 34·9, $\dot{H}$ 5·7, $\ddot{B}$ (by loss) 21·2. G.=3.—(*Kenngott, Uebersicht*, 1860, 57.)

The peculiar massive *datholite* described by J. D. Whitney (this Journal, [2], xxviii, 13), has been further examined by A. A. Hayes (*Proc. Bost. Soc. Nat. Hist.*, viii, 62). The specimens examined were from the Isle Royale, Quincy, Marquette, Minnesota and "Ash-bed" mines. The mineral is compact, resembling some varieties of Wedgewood-ware. H.=5·5. Other physical properties the same as already given by Whitney. Analyses of two specimens gave:

$\ddot{S}i$	$\dot{B}$	$\dot{C}a$	$\dot{F}e\,\dot{A}l$	$\dot{C}u$	$\dot{H}$	quartz.		
38·32	22·64	32·82	1·04	0·80	3·98	0·80	=	99·68
37·92	22·16	33·64	—	—	3·96	2·08	=	99·76

It contains less water than is given for crystallized datholite, and Dr. Hayes suggests the possibility that in former analyses the water may have been given too high, owing to loss of boric acid by exposure to intense ignition.

[Dr. Hayes calls attention to this mineral as being sometimes confounded with pectolite. It is quite remarkable that datholite, pectolite and wollastonite are all found at Lake Superior in compact masses, differing entirely in appearance from these minerals as found at other localities. The compact datholite is of frequent occurrence; during the past summer I observed it at many of the mines in the Portage Lake, Keweenaw and Ontanagon districts. Very fine specimens occur at the Superior Mine near Ontanagon.—G. J. B.]

Dechenite [p. 362, III, IV, VIII].—The *rhombic vanadinite* from Kappel in Carinthia, described by Zippe, has been analyzed by G. Tschermak (*Wien. Akad. Ber.*, xlvi, 157).

	$\dot{P}b$	$\dddot{V}$
G.=5·83.	54·3	45·7 = 100.

A trace of zinc was also found. Tschermak considers it as identical with *dechenite*.

DELEMINZITE—*Breithaupt, Berg und Hüttenmännische Zeitung*, xxi, 98.—Breithaupt gives this name to what he considers to be a new form of sulphid of silver, differing from silver-glance and akanthite. It is isomorphous with copper-glance. The angle of the prism was determined to be 116°. G.=7·02. Named after Deleminzin, the ancient name for Freiberg. Locality of the mineral not stated, but it is probably from Freiberg.

Dianite [Suppl. IX].—Damour and Deville have shown that v. Kobell's dianic acid is identical with hypocolumbic acid, consequently this mineral can no longer be considered as distinct from tantalite.—(*Comptes Rendus*, liii, 1,044.)

Domeykite [p. 36, V].—F. A. Genth confirms the observations of Hunt and Whitney in regard to the occurrence of a mixture of domeykite and copper-nickel in the ore from Michipicoten Island. He also gives analyses of the domeykite recently found on the Sheldon location at Portage Lake. It is massive; hardness, a little below that of fluor. G. at 16° C 7·75. Color, on fresh fracture, tin-white to steel-gray, quickly tarnishing, first into yellow and pinchbeck, afterwards showing pavonine tints, and finally becoming brown. Lustre, metallic when fresh, but dull after exposure. Fracture uneven, subconchoidal. Associated with quartz and arseniate of copper. Analyses:

	As	Cu		
1.	29·25	70·68	=	99·93
2.	29·48	70·01	=	99·59

Analysis I contained 0·55, and II. 6·71 pr. ct. quartz. Excluding the quartz, they give the formula Cu^3As=As 29·25, Cu 71·68—(this Journal, xxxiii, 193).

Analysis of *domeykite* from the Corocora Copper Mines, by D. Forbes (*Quar. Jour. Geol. Soc.*, xvii, 44):

Cu	Ag	As
71·13	0·46	28·41

It was found in the form of gray metallic grains, disseminated in sandstone.

Dufrenite [p. 427, IV].—F. Pisani has analyzed *dufrenite*, from Rocheforten-Terre, (Morbihan, France,) where it occurs in dark green kidney-shaped masses, with limonite and cacoxene (?). Composition:

$\dot{P}$	$\dot{F}e$	$\dot{A}l$	$\dot{H}$		
28·53	54·40	4·50	12·40	=	99·83

giving the oxygen ratio for $\dot{P}$, $\dot{F}e$, $\dot{H}$, 10 : 12 : 7, or $2(\dot{F}e\ \dot{A}l)^2\dot{P}+7\dot{H}$.—*Comptes Rendus*, liii, 1020.

Engelhardite.—See ZIRCON.

EPIDOTE [p. 206, II–VII. IX].—Dr. Genth has described an interesting variety of *lime epidote*, from the Polk County Mine, Tennessee. It occurs in large but indistinct crystals, lengthened parallel to *ii*, which plane is best developed and can be seen on every crystal; some crystals also show the planes $1i$ and $\frac{1}{2}i$. Cleavage very distinct parallel to *ii*. The color is gray, with a bluish-green or greenish-brown tint. (Some specimens are white, with a tinge of pink.—G. J. B.) G.=3·344. The larger crystals are frequently intermixed with chalcopyrite, pyrites and quartz. Analyses No. 1, by Genth, No. 2, by Trippel, of a coarse grained, confusedly crystalline variety, partially decomposed, and associated with blende, harrisite, garnet, etc.

	$\dot{S}i$	$\dot{A}l$	$\dot{F}e$	$\dot{M}n$	$\dot{C}a$	$\dot{M}g$	$\dot{C}u$	$\dot{K}$	Ign.	
1.	40·04	30·63	2·28	0·19	25·11	*tr.*	0·24	—	0·71	=99·20, Genth.
2.	43·20	29·60	2·88	—	22·72	0·56	—	*tr.*	0·26	=99·22, Trippel.

Other partial analyses are given—(this Journal, [2], xxxiii, 197).

FELDSPAR [p. 228, I–III, IX].—S. D. Hayes has investigated the properties of fused feld-par (*Pogg. Ann.*, cxiii, 468). His results show that feldspar suffers no material change in its composition by fusion. [It is well known that feldspar is found as a furnace-product.—G. J. B.]

For analyses of *orthoclase*, from Lauterberg and Holzemmenthal, made in the Clausthal Laboratory, see *B. und H. Zeitung*, xx, 265. Analysis of *glassy feldspar*, from Löwenburg, by G. vom Rath, *Zeitschr. Geol. Gesellsch.*, xii, 44. For other analyses, see Kenngott, *Uebersicht*, 1860, 63–65.

FICHTELITE [p. 472, V].—T. E. Clark shows the crystals of this resin to be monoclinic. The crystals obtained were from a solution in alcohol and ether (*Ann. d. Chem. u. Pharm.*, cxix, 226).

FLUOR [p. 94, II].—The fetid *fluor* from Wölsendorf, in the Palatinate, in which Schafhäutl thought to have discovered hypochlorite of lime (Min. 94), has been examined by Schrötter, (*Sitzungsber. Acad. d. Wissensch., Wien.* xli), who announces that the so-called hypochlorous acid is ozone. More recently the same variety of fluor has been examined by Schönbein, and, according to his views, the so-called ozone is antozone (*Jour. prakt. Chem.*, lxxxiii, 95). Schönbein estimates that the mineral contains $\frac{1}{30'000}$ part of its weight (·02 pr. ct.) of this substance, and suggests that this variety of fluor should be called *antozonite*. This very convenient designation should not be received into mineralogical nomenclature as a synonym of fluor, much less as the name of a new species.

FREIESLEBENITE [p. 99, III, IV].—A. Reuss announces the discovery of this rare mineral, at Przibram, in Bohemia. It is found in isolated crystals, from two to six lines in length; usually the crystals are twined. Prismatic cleavage, perfect; fracture, uneven to sub-conchoidal. H =2·53. G.=6·23. Color steel-gray to blackish-gray. B.B. decrepitates and gives reactions for sulphur, antimony, lead and silver. Analysis by Von Payr:

Sb	S	Ag	Pb	Fe		
27·11	18·41	23·08	30·77	0·63	=	100·00

Lotos, 1859, p. 51–56, in *Jahrb. Min.*, 1860, 579.

Fournetite.—See TETRAHEDRITE.

GALENA [p. 39, II–IV, VII–VIII].—Breithaupt has examined the so-called pseudomorphs of galena, after pyromorphite from Bernkastel, on the Mosel, and concludes that they are not pseudomorphs, but true hexagonal prisms of sulphid of lead. He finds that they possess no trace of cubic cleavage, but that they have a perfect basal

cleavage and an imperfect prismatic cleavage. The crystals often occur with pyromorphite. Some specimens of stalactitic sulphid of lead, examined by Breithaupt, were also found to have this peculiar cleavage. Breithaupt considers that the low specific gravity of the crystals, 6·82 to 6·87, is remarkable, but he gives no chemical analysis to prove that substance he examined was pure sulphid of lead; it may have contained unaltered *pyro*morphite. He proposes the name *sexangulite* for this variety of galena (*B. and H. Zeitung*, xxi, 99).

For Dr. Genth's paper on copper-glance, pseudomorphous of *galena*, see COPPER-GLANCE.

Gamsigradite.—See HORNBLENDE.

GARNET [p. 190, I–IX].—Analysis of green garnet, from serpentine at Dobschau, in Hungary, by Tschermak: $\dot{S}i$ 38, $\dot{F}e$ 28, $\dot{A}l$ 3, $\dot{C}a$ 30, $\dot{M}g$ 2=101. G=3·72.—*Kopp's Jahresbericht*, 1860, 766.

GLAUBERITE [p. 374].—Pisani has found a brick-red friable and resinous-like variety of *glauberite*, associated with polyhalite and anhydrite, in common salt, at Varengeville, near Nancy. Composition: $\dot{N}a\ \ddot{S}$ 50·50, $\dot{C}a\ \ddot{S}$ 48·78, clay 0·40= 99·68.—(*Comptes Rendus*, li, 731, in Kopp's *Jahresbericht*, 1860, 788.)

Glossecollite.—See HALLOYSITE.

GOLD [p. 7, I, II, V–VII, IX].—O. C. Marsh, in a paper on the Gold of Nova Scotia, gives analyses of gold from Tangier and Lunenburg:

		Au	Ag	Cu	Fe		
Tangier,	G.=18·95	98·13	1·76	·05	*tr.*	=	99·94
Lunenburg,	G.=18·37	92·04	7·76	·11	*tr.*	=	99·91

A specimen from Lawrencetown had a density of 18·60, indicating a composition between that of the Tangier and the Lunenburg specimens. The Tangier gold is remarkable for its purity, being only surpassed in this respect by that from Schabrowski (this Journal, xxxii, 399).

F. A. Genth has found Gold pseudomorphous of *aikinite*. The exact locality of the specimen was doubtful, but was stated to be from Georgia. A portion of the aikinite was unaltered, but it was mostly converted into the well-known pseudomorph, a cupreous carbonate of bismuth. This latter was found in slender needles, of different degrees of purity; lustre, waxy; color, pistachio or oil green; when earthy, greenish-white. In the centre of many of the crystals was bright yellow gold, of a high degree of fineness, in some cases distinctly showing the rhombic form of the original mineral (this Journal, [2], xxxiii, 190).

J. Tennant describes a mass of gold found at Bakery Hill, Ballarat, in Australia, in 1858, which weighed 2 217 ounces, or 184 pounds 8 ounces. It was melted in London, in September, 1859, and yielded £8,376 10s. 10d. sterling of Gold.—(*Pogg. Ann.*, cxii, 644, *Brit. Assoc. Report*, 29th Meeting, p. 85.)

GYROLITE [p. 305, I].—H. How has discovered *gyrolite* near Margaretville, Nova Scotia. It occurs imbedded in crystalline apophyllite in spherical concretions of pearly lustrous plates, varying in size from a pin's-head to nearly half an inch in diameter. Composition:

$\ddot{S}i$	$\dot{C}a$	$\dot{A}l$	$\dot{M}g$	$\dot{K}$	$\dot{H}$		
51·90	29·95	1·27	0·08	1·60	15·05	=	99·85

giving the formula, $\dot{C}a\ \ddot{S}i + 1\frac{1}{2}\dot{H}$, and corresponding nearly with Anderson's analysis of the mineral from the Isle of Skye. How calls attention to the close relation of this mineral to apophyllite, and suggests that the existence of carbonate of lime in the cavities with the gyrolite, would seem to show that the latter is formed from apophyllite by the waters which deposited the carbonate of lime, reacting on the silicate of potash, and dissolving out at the same time the fluorid of calcium (this Journal, [2], xxxii, 13).

HALLOYSITE [p. 251, VII].—F. Pisani has analyzed Shepard's *glossecollite*, and proved it to be identical with *halloysite* (*Comptes Rendus*, lii, 310). The specimen examined was received from Des Cloizeaux, who gives the following characters for

the mineral. It is compact, with conchoidal fracture; dull, but becomes lustrous on rubbing; color, white; soft and very friable; adheres strongly to the tongue. In water does not soften, but becomes translucent and opaline on the edges, disengaging a few bubbles of air and an argillaceous odor. Heated in the closed tube gives off water, and becomes bluish-gray. B.B. infusible, with cobalt solution gives a blue color. Decomposed by sulphuric acid. Composition:

$\ddot{S}i$	$\dot{A}l$	$\dot{M}g$	$\dot{H}$		
40·4	37·8	0·5	21·8	=	100·5

Shepard described it as pure hydrated silicic acid ($Si\,O_3$, HO).

Harrisite.—See COPPER-GLANCE.

HAUYNE [p. 230, IX].—Analysis of *hauyne*, from the lava of Melfi, by Rammelsberg:

$\ddot{S}$	$\ddot{S}i$	$\dot{A}l$	$\dot{C}a$	$\dot{M}g$	$\dot{N}a$	$\dot{K}$	Cl	
G.=24·66	11·08	34·88	29·34	5·54	0·70	14·47	3·76	*tr.* = 99·77

(*Zeitschr. geolog. Gesellsch.*, xii, 273, in Kopp's *Jahresbericht*, 1860, 776).

HORNBLENDE [p. 170, I–IV, VI–VIII].—Breithaupt has given the name *gamsigradite* to a black hornblende from Gamsigrad, in Servia. It has a vitreous lustre, velvet-black color, a greenish-gray streak, and is opaque. Cleavage, prismatic. H.=6. G.=3·12. Analysis by R. Müller (*B. and H. Zeitung*, xx, 53):

$\ddot{S}i$	$\dot{A}l$	$\dot{F}e$	$\dot{M}n$	$\dot{C}a$	$\dot{M}g$	$\dot{N}a$	$\dot{K}$	
46·58	13·63	12·29	6·00	8·83	8·44	3·17	1·00	= 99·94

[The large amount of manganese is quite remarkable; the oxygen ratio, as given by the author, for the bases and silica, is as 16·98 : 24·04 or 2 : 3. It is noteworthy that Rammelsberg, in his extended researches on hornblende, almost invariably found that a portion of the iron in the ferruginous-aluminous varieties was in the state of sesquioxyd.—G. J. B.]

ILMENITE [p. 115, V, VII].—Analysis of titanic iron, from Maxhofen, Bavaria, by J. Müller:

$\dot{T}i$	$\dot{F}e$	$\dot{M}n$	$\dot{A}l$	$\ddot{S}i$	$\dot{C}a$	
51·60	41·79[a]	4·00	1·57	0·90	0·30	= 100·166

[a] With *tr.* $\dot{F}e$.

Occurs in irregular brittle nodules, of an iron-black color, black streak and sub-metallic lustre. H.=5. G.=4·692 (Kopp, *Jahresbericht*, 1859, 775).

IOLITE [p. 214, VII].—N. V. Kokscharow has found *iolite* at Mursinska, in the Ural, where it occurs in masses of the size of a walnut, associated with albite and andalusite. Color, reddish brown; translucent; lustre, vitreous to waxy. H.=7·5. G.=2·605. Chemical examination by Hermann: Heated in the closed tube gives water, and changes color from brown to light blue. B.B. fuses with difficulty to a white enamel. Composition:

$\ddot{S}i$	$\dot{A}l$	$\dot{F}e$	$\dot{M}n$	$\dot{M}g$	$\dot{L}i$	$\dot{H}$	
50·65	30·26	4·10	0·60	11·09	0·64	2·66	= 100·00

—*Mat. Min. Russlands*, iii, 253, *in Kopp's Jahresbericht*, 1860, 767.

IRITE [p. 103].—Claus considers that this mineral, described by Hermann as a compound of oxydized platinum metals with the oxyds of iron and chromium, is nothing more than a mechanical mixture of several substances. Aside from the improbability of obtaining a pure mineral by the washing of such a complicated mixture as the platinum-residue, Claus made a microscopical examination of the substance obtained by Hermann's method of separation, and found it to be a mixture of several substances, but consisting chiefly of iridosmine and chromic iron.—(*Jour. prakt. Chem.*, lxxx, 285.)

IRON [p. 17, II, VIII].—Boussingault has found traces of nitrogen in the meteoric iron of Lénarto (*Ann. de Chim. et de Phys.*, (3,) lxiii, 336.)

KÄMMERERITE [p. 291].—N. B. DeMarny has found *kämmererite* with chrome-iron in the district of Ufaleisk, in the Ural (*Bull. Soc. Nat., Moscou*, 1860, p. 200). The mineral occurs in imbedded crystals, which in their physical character, very much resemble the clinochlore from Achmatowsk. The crystals have a basic cleavage, and the prismatic faces are horizontally striated. The large crystals are sometimes an inch in diameter, and have a black color and vitreous lustre; the basic planes have a pearly lustre and violet color. The small crystals are transparent, and are of a carmine-red color. Sp. Gr. 2·731.

KEROLITE [p. 280].—Analysis of a bluish-white *kerolite*, from Harford County, Maryland, by F. A. Genth (this Journal, [2], xxxiii, 203):

	$\ddot{S}i$	$\dot{F}e$	$\dot{M}g$	$\dot{H}$	
1.	51·20	0·22	26·81	undet.	
2.	51·09	0·23	28·28	20·91	= 100·51
3.	51·02	0·26	27·91	undet.	

KIESERITE.—*Reichardt, Das Salzbergwerk Stassfurth bei Magdeburg*, 1860, in Kopp's *Jahresbericht*, 1860, p. 788.—This name has been given by Reichardt to a salt from Stassfurth, in which he found $\dot{M}g$ 21·66, $\ddot{S}$ 43·05, $\dot{H}$ 34·56=99·27; this gives the formula $\dot{M}_2\ddot{S}+3\dot{H}$. Subsequent analyses made by M. Siewert and B Leopold differed from Reichardt's results, in containing two equivalents less of water.

The substance examined by Siewert consisted of two parts; one portion was opalescent, translucent and friable, while the other was of a darker yellow color, opaque and much harder than the first named. The first was not materially altered when heated at 100° C.; it dissolved in nitric acid, leaving a residue of 0·26 to 0·66 pr. ct., and contained a trace of chlorine; excluding these last as impurities, the composition is represented by analyses 1 and 2. The harder portion gave a residue of 1·5 pr. ct.; when treated with hot water, the residue consisted of sulphate and borate of magnesia. Leopold also found from 0·5 to 1·2 pr. ct. insoluble borates mixed with the specimens he examined.

	$\ddot{S}$	$\dot{M}g$	H	
1.	58·98	28·51	13·47	Siewert.
2.	58·90	28·61	——	"
3.	57·78	28·78	14·13	Leopold.

These give the formula $\dot{M}g\ddot{S}+\dot{H}$.

KÖNLEINITE [p. 472, II].—According to Kenngott, the determinations of J. Fritzsche show that the *könleinite* from Redwitz has the same composition as his so-called hydro-carbon *retén*, $C_{36}H_{18}$, and that this species also occurs at Uznach. At the latter locality, könleinite is associated with *scheererite;* at Redwitz it is accompanied by *fichtelite*. It was questioned whether scheererite and fichtelite were identical, but this was not determined. The so-called *phylloretin* was also proved to be identical with *könleinite*.—(*Bull. Acad. St. Petersbourg*, iii, 88, Kenngott, *Uebersicht*, 1860, 116.)

LABRADORITE [p. 237, VII–IX].—For analyses of *labradorite*, from the black porphyry of Elbingerode and Rübeland, made in the Laboratory at Clausthal under the direction of A. Streng, see *B. and H. Zeitung*, xx, 265.

LANTHANOCERITE (*Hermann, J. pr. Chem.*, lxxxii, 406).—In a paper on cerite, Hermann asserts that two minerals have been known by this name. One, the true *cerite*, loses by ignition from 5 to 6 pr. ct., contains only a very little carbonic acid, and but 7 to 8 pr. ct. of the oxyds of lanthanum and didymium, while it contains from 56 to 64 pr. ct. of oxyd of cerium. The other mineral, which Hermann names *lanthanocerite*, loses 10 to 12 pr. ct. on ignition, contains 4 to 5 pr. ct. of carbonic acid and 34 pr. ct. of oxyds of lanthanum and didymium, and only 26 pr. ct. of oxyd of cerium. Hermann gives no physical characters to distinguish this new species, and quotes his former analyses (see Min., p. 812, Anal. 2, under Cerite,) with merely the additional determination of the relative amounts of the oxyds of lanthanum and didymium present, as follows:

$\ddot{S}i$	$\ddot{A}l$	$\dot{C}e$	$\dot{L}a$	$\dot{D}i$	$\dot{M}n$	$\dot{F}e$	$\dot{C}a$	$\dot{M}g$	$\ddot{C}$	$\dot{H}$
16·06	1·68	26·55	16·33	18·05	0·27	3·17	3·56	1·25	4·62	8·10

with traces of cobalt and copper.

Hermann writes the formula: $4(\dot{R}^2\ddot{S}i+\dot{H})+(2\dot{R}_2\ddot{C}+3\dot{H})$.
It seems most probable that the mineral may be an altered substance, or, perhaps a mixture of cerite and lanthanite.

Lapis-Lazuli [p. 229, VI, VII, IX].—Analysis of *lapis-lazuli*, from Ditro, in Siebenbürgen, by C. v. Hauer (Kenngott, *Uebersicht*, 1860, 54):

	$\ddot{S}i$	$\ddot{A}l$	$\dot{F}e$	$\dot{C}a$	$\dot{N}a$	$\ddot{S}$
G. = 2·31	40·54	43·00	0·86	1·14	12·54[a]	1·92[b]

[a] By the difference. [b] Loss on ignition.

Found in a hornblendic vein in syenite, associated with pyrites and sphene.

Lazulite [p. 404, II, VII].—E. J. Chapman has published an article on the *lazulite* from Graves' Mountain, Georgia, in which he endeavors to show that the form is trimetric instead of monoclinic (Canadian Journal, July and September, 1861). In his first article on the subject, Prof. Chapman erroneously considered the crystals as coming from Sinclair county in North Carolina, and he overlooked the fact that the crystals had already been figured by Prof. Dana in Prof. Shepard's article on lazulite in this Journal [2], xxvii, 36. The habit of the crystals and the modifications are monoclinic, and this evidence appears to outweigh that from measurements of crystals having so little lustre. It seems to be a case like datholite, which for a long time was thought to be trimetric, but is now known to be monoclinic.

Laumontite [p. 307, IV–VI].—Analyses of altered *laumontite* from Lake Superior, by Lewinstein show that the crystals are partially converted into feldspar (orthoclase?)—Kopp, *Jahresbericht*, 1860, 771.

Lepidolite [p. 226, 508].—In connection with the discovery of the two new alkaline metals *cæsium* and *rubidium* by Bunsen and Kirchhoff, a new analysis of the Rozena *lepidolite* has been made in Bunsen's Laboratory by Cooper. To determine the rubidium with accuracy 13·509 grammes of lepidolite were used.

$\ddot{S}i$	$\ddot{A}l$	$\dot{F}e$	$\dot{C}a$	$\dot{M}g$	$\dot{R}b$	$\dot{C}s$	$\dot{L}i$	LiFl	NaFl	KFl	$\dot{H}$
50·32	28·54	0·73	1·01	0·51	0·24	*tr*	0·70	0·99	1·77	12·06	3·12=99·99

The total amount of fluorine replacing oxygen is 5·48 per cent.—(*Jour. Prakt. Chem.*, lxxxv, 125.)

Messrs. O. D. Allen and J. M. Blake, of the Sheffield Laboratory, have examined the lepidolite from Hebron and Paris in Maine, and found it to contain very considerable quantities of cæsium and rubidium.

Leucite [p. 231, III, V, VI, IX].—Analysis of *leucite* from Vesuvian lava of 1858 by Rammelsberg:

$\ddot{S}i$	$\ddot{A}l$	$\dot{K}$	$\dot{N}a$	$\dot{C}a$	
57·24	22·96	18·61	0·93	0·91	= 100·65

—*Zeitschr. Geolog. Gesellsch.* xi, 496, *in Kopp's Jahresbericht*, 1860, 760.

Lievrite [p. 262, IV].—For an article by E. J. Chapman on the position of this species in the mineral series, see Canadian Journal for January, 1862.

Linarite [p. 390.]—This rare mineral has been found by von Kobell among the lead ores from Vadainsk's Mine in the Nertschinsk District, Siberia, (*J. Pr. Chem.*, lxxxiii, 454). The mineral occurs in radiated clusters of small crystals of an azure-blue color. Measured with the microscope the cleavage angle was 103°. B.B., decrepitates, when slowly heated fuses in the flame of a candle. Analysis gave:

$\dot{P}b\ddot{S}$	$\dot{C}u$	$\dot{H}$ with tr. Cl	
76·41	17·43	6·16	= 100·00

Von Kobell remarks that the slight excess of sulphate of lead and water, was due to an admixture of earthy anglesite.

LOEWIGITE [*A. Mitscherlich J. pr. Chem.*, lxxxiii, 474].—This name has been given by Mitscherlich to the variety of *alunite*, analyzed by Löwig (Sup. V). It is found with *alunite*, at Tolfa in Hungary, as well as at Tabrze in Siberia. It contains the same constituents as *alunite* with the exception of nine instead of six

equivalents of water. This water is expelled at a lower heat than in the case of alunite, and the resultant compound instead of containing a mixture of soluble alum and insoluble alumina, consisted of a mixture of sulphate of potash with subsulphate of alumina. It is partially soluble in chlorhydric acid, while alunite is perfectly insoluble. Analyses:

	K̇	Ṅa	Ä̇l	Ḟe	S̈	Ḣ	Ṁg	Ḃa	Ċa	S̈i	X(a)	Z(b)
Tabrze,	9·30	0·39	34·95	0·68	34·81	17·88	0·55	0·44	0·28	0·26	0·47	——
Tolfa,	7·17	——	26·29	——	27·63	12·04	3·21	——	0·07	——	——	23·59

a Organic substances. *b* Silicates.

Excluding the silicates in the Tolfa mineral, calculation gives K̇ 9·63, Ä̇l 36·01, S̈ 37·86, Ḣ 16·50. The formula K̇ S̈+3Ä̇lS̈+9Ḣ=K̇ 10·66, Ä̇l 34·84, S̈ 36·18, Ḣ 18 32.

Margarite [p. 300, IV].—An analysis of so-called margarite from Pfitschthale near Sterzing, made by Oellacher is given in Kenngott's Uebersicht for 1860, p. 49, It differs entirely in composition from the true *margarite* as analyzed by Hermann, Smith and Brush. Composition:

	S̈i	Ä̇l	Ḟe	Ċa	Ḃa	Ṡr	Ṁg	Ḟe	Ṁn	K̇	Ṅa	Ċu	Ḣ
G.=2·894	42 59	30·18	0·91	1·03	4 65	0·09	4·85	1·74	0·12	7 61	1·42	0·31	4·43

[A special examination for alkaline earths in the Sterzing margarite made under my direction by Mr. O. D. Allen, proves that it contains no baryta, and only a faint, unweighable trace of strontia. A solution of the alkaline earths from a gramme of the mineral gave, after long standing, a slight turbidity with sulphate of lime. The spectroscope showed the presence of strontia and lime, but not any trace of baryta. —G. J. B.]

Margarodite [p. 223, VIII].—A variety of mica from Derby, Vt., has been named *adamsite* by Prof. C. U. Shepard, on account of some supposed peculiar physical properties (*Hitchcock's Geology of Vermont*, vol. i, p. 484). It is found in thickly disseminated crystals in mica-slate, and Shepard remarks that "its crystalline form is that of mica and but for its perfect inelasticity and greater hardness, it might coalesce with this species." [We do not understand exactly what is meant by "*this species*," as every one knows that there are several species of mica. The specimens of mineral from Derby, Vermont, received from Prof. Shepard, and examined by the writer, have the same hardness, lustre, elasticity, cleavage, specific-gravity, blowpipe characters and chemical composition as margarodite. Analysis gave,

S̈i	Ä̇l Ḟe	Ċa	Ṁg	Alkalies.	Ign.
47·76	36·29	0·24	1·85	8·77*a*	5·09 = 100·00

a By difference.

This corresponds very closely with the analyses of margarodite from Monroe, Ct., by Smith and Brush. This identity, and the exact correspondence of its physical properties with margarodite from different localities, leave no doubt as to the propriety of classing the so-called adamsite with this kind of mica.—G. J. B.]

J. Apjohn describes (*Dub. Quar. Jour. Sci.*, i, 119) a new locality of *margarodite* at Ross-Hill, near Maum, Ireland. It has a curved, foliated structure, the laminae not being parallel in masses of any size, but intersecting at various angles. Color white, with tinge of yellowish-green: lustre pearly, sub-translucent. Hardness over 2. G.=2·802. Difficultly fusible. Composition:

S̈i	Ä̇l	Ḟe	Ċa	Ṁg	K̇	Ṅa	Ḣ
46·42	37·92	0·46	0·67	0·17	9·63	1·54	4·40 = 101·21

Martite [p. 102, VII].—Dewalque has described an octahedral sesquioxyd of iron from Frassem near Arlon in Luxemburg. Occurs in regular octahedrons in sandstone. Color black; lustre generally dull; fracture earthy, showing no cleavage; streak brick red; sp. gr. 4·35; hardness 7·5. Composition Ḟe, with 0·33 S̈i, 0·37 Ä̇l, and traces of Ċa and Ṁg with 0·2 S. The sulphur indicates it to be a product of the decomposition of pyrites.—(Kopp, *Jahresbericht*, 1860, 775.)

Mica.—For analyses of Black Mica from Canton (Ireland) granite by S. Haughton, see Quar. Jour. Geol. Soc. Dublin, viii, 160.

MILLERITE [p. 49, I].—F. A. Genth has given analyses of the *millerite* from Gap Mine, Lancaster county, Pennsylvania. (This Journal [2], xxxiii, 195.) It there occurs in coatings of a radiated structure of $\frac{1}{16}$ to $\frac{1}{4}$ of an inch in thickness or concentrically radiated semi-globular masses or tufts. It is frequently tarnished, and many pieces show a commencing alteration into copper-glance, they are dull, of a black color at the upper part of the tufts or little crystals, while the lower part has the brass yellow color and metallic lustre of millerite. Two analyses—No. 1, finest millerite—No. 2, partly altered millerite.

	S	Cu	Ni	Co	Fe	Insol.
1.	35·14	0·87	63·08	0·58	0·40	0·28=100·35
2.	33·60	4·63	59·96		1·32	0·54=100·05

MONAZITE [p. 402, V].—F. A. Genth mentions a crystal of this species from the gold washings of Todd's branch, Mecklenburgh county, N. C., associated with diamond, garnet and zircon. It is $\frac{1}{4}$ of an inch long, a little over $\frac{1}{8}$ wide and somewhat less than $\frac{1}{8}$ thick, of a yellowish brown color and shows distinctly the following planes: 1, 1*i*, *ii*, *I*, -1 and *i*$\breve{i}$. The crystal being slightly waterworn has the edges somewhat rounded, by which some other planes may have been obliterated. G. at 12° C.=5·203. (This Journal [2], xxxiii, 204.)

NAGYAGITE [p. 65, VIII].—An analysis of *nagyagite* disseminated through a rock from Nagyag gave S. J. Kappel after excluding foreign matter,

S	Au	Fe	Se	Ag	Pb
8·56	12·75	15·11	1·66	1·82	60·10

Kopp, *Jahresbericht*, 1859, 770.

OPAL [p. 151, III, IV, VI].—A variety of *hydrophane* from the meerschaum mines near Thebes (Greece) analyzed by G. Tschermak gave,

	$\ddot{S}i$	$\dot{M}g$	$\dot{H}$
G.= 2·11 (at 0° C.)	85·8	4·9	9·4=100·1

Wien. Akad. Ber. xliii, 381.

ORTHOCLASE [p. 242, II, III, V–VIII]. — G. vom Rath gives in *Pogg. Ann.* cxiii, 425, measurements of crystals of *adularia* from Ruäras.

Analyses of feldspar from the granite of Canton, Ireland, by S. Haughton (Jour. Geol. Soc. Dublin, viii, 159).

$\ddot{S}i$	$\ddot{A}l$	$\ddot{F}e$	$\dot{C}a$	$\dot{M}g$	$\dot{K}$	$\dot{N}a$	Ign.
64·48	19·12	0·56	0·45	*tr.*	12·52	3·24	0·16=100·53

PHOLERITE [p. 251, VIII, IX].—Analysis of *pholerite* from Lodève, Dept. Herault (France), by F. Pisani (*Comptes Rendus*, liii, 1072),

$\ddot{S}i$	$\ddot{A}l$	$\dot{H}$
47·0	39·4	14·4=100·8

giving the formula $\ddot{A}l^3\ddot{S}i^4+6\dot{H}$

PINITE [p. 45].—A. Streng has communicated an analysis of a mineral which he supposes to be identical with Knop's pinitoid (anal. 1). It occurs at Auerberg. No physical characters are given except the specific gravity, 2·75. Streng also gives an analysis of *pinite* (anal. 2) from Mühlenthal, near Elbingerode, where it is found in greenish-gray twelve sided lustreless prisms of a hardness of 2-3. The crystals are often covered with a thin brownish crust. G.= 2·62.—(*B. & H. Zeitung*, xx, 266).

A substance of similar composition from the porphyritic granite of Sasbachwald by Sandberger (anal. 3), by whom it was considered a product of the decomposition of oligoclase (Kenngott, *Uebersicht*, 1860, 39).

	$\ddot{S}i$	$\ddot{A}l$	$\ddot{F}e$	$\dot{C}a$	$\dot{M}g$	$\dot{K}$	$\dot{N}a$	Ign		
1.	50·95	30·62	2·48	0·35	0·35	9·74	0·12	5·25	=	99·86
2.	47·51	31·17	1·85	1·24	1·55	7·23	0·15	9·02	=	99·72
3.	50·43	28·89	——	3·45	5·12	3·68	5·84	=	97·44	

For Nessler's analysis of *oosite*, a pinite-like substance from Oosthal near Baden, see Kenngott's *Uebersicht*, 1860, 42.

PLATINUM [p. 12, II, III, VI, VIII].—B. Cotta has observed *platinum*, associated with chrome-iron, in what appeared to be a yellowish-serpentine, from the gold district of Nischne-Tagilsk (Kopp, *Jahresbericht*, 1860, 743).

POLYBASITE [p. 85].—Analysis of polybasite, from Przibram, in Bohemia, by Tonner:

	Ag	Cu	Fe	Sb	S	
G.=6·03	68·55	3·36	0·14	11·53	15·55	= 99·13

Lotos, 1859, 85, in *Jahrb. Min.*, 1860, 716.

PREHNITE [p. 314].—Nöggerath describes the occurrence of prehnite, associated with fluor-spar, from Fassathal, in Tyrol (*Sitzungsberichte der niederrheinischen Gesell., Bonn*, vii, 8).

PROUSTITE [p. 78, IX].—Dr. Genth has discovered microscopic crystals of *proustite*, associated with native silver, at the McMakin Mine, Cabarras Co., North Carolina, [this Journal, [2], xxxiii, 195).

PSILOMELANE [p. 135].—Analysis of *psilomelane*, from Loeh Mine, near Olpe, by K. List:

	Ṁn	M̈n	O	Ċu	Ċo	Ċa	K̇	Ḣ	Insol.
G.=4·699	85·17		4·49	1·28	0·31	0·37	1·36	4·02	2·51

List gives the formula, $\dot{M}n^2$, $\ddot{M}n^2+\dot{H}$. The mineral examined was remarkably pure. —(*Jour. prakt. Chem.*, lxxxiv, 60).

PYROPE [p. 194].—F. A. Genth has analyzed the *pyrope* from near Sante Fé, New Mexico. It has a deep blood-red, sometimes brownish-red color, and forms small somewhat angular grains, from $\frac{1}{3}$ to $\frac{1}{4}$ inches in diameter. G.=3·738. Composition:

S̈i	Ä̇l	C̈r	Ḟe	Ṁn	Ċa	Ṁg	Ign.	
42·11	19·35	2·62	14·87	0·36	5·23	14·01	0·45	= 99·00

Considering the chrome as sesquioxyd, and the iron as protoxyd, the oxygen ratio for S̈i, R̈, Ṙ, is as 20·86 : 9·85 : 9·47, or very nearly 2 : 1 : 1=$\dot{R}^3\,\ddot{S}i+\ddot{R}\,\ddot{S}i$, the formula of garnet—(this Journal, [2], xxxiii, 196).

PYROSMALITE [p. 310.—This rare species has been reëxamined by J. Lang (*Jour. prakt. Chem.*, lxxxiii, 424]. It is only found at the mines near Philipstedt, in Wermland, and occurs there in hexagonal prisms, of sometimes an inch in length, imbedded in calcite. Color, blackish-green to liver-brown. H.=4 5. G =3·168-3·174. Decomposed by both nitric and chlorhydric acid. The mean of all the determinations, including two complete analyses, gave:

S̈i	Ḟe	Ṁn	Ä̇l	Ċa	Cl	Ḣ
35·43	30·72	20·51	0·24	0·74	3·79	7·75

A special determination showed that only 0·79 of the iron was sesquioxyd; this small amount was thought to be due to a slight alteration of the mineral, or, perhaps, from an error in titration. Lang considers, therefore, that the mineral consists of protochlorid of iron, and a silicate of protoxyd of iron. The formula may be written $3FeCl+4(\dot{R}^3\,\ddot{S}i+2\dot{R}^3\ddot{S}i^2+6\dot{H})$.

PYROXENE [p. 158, I, II, V–IX].—Analysis of *pyroxene*, from the Vesuvian lava of 1858, gave Rammelsberg S̈i 49·61, Ä̇l 4·42, Ḟe 9·08, Ċa 22·83, Ṁg 14·22, F̈e undet.= 100·16.—Kopp, *Jahresbericht*, 1860, 758.

Des Cloizeaux has shown, by optical examination, that *enstatite*, *bronzite*, *hypersthene* and *wollastonite* are distinct from *pyroxene* in their crystalline form and optical properties (*Comptes Rendus*, lii, 786). For analysis of a pyroxene pseudomorph, by Pisani, see *Comptes Rendus*, liv, 51.

PYROPHYLLITE [p. 303, I, V, VI, VII].—In an examination of different varieties of Chinese figure-stone (pagodite) made in 1858, I found a compact variety of pyrophyllite, which seemed to bear the same relation to ordinary pyrophyllite as steatite does to talc. In chemical composition it was identical with the radiated mineral, but it differed in hardness and pyrognostic characters. Since the publication of this result, I have examined a large number of so-called steatites, and have found among

them many specimens of this compact pyrophyllite. Among these specimens is a so called soapstone, from Deep River, Moore Co., North Carolina. It has a schistose, or imperfectly lamellar structure, resembling talcose-slate. Laminæ, not sufficiently distinct to be separable; brittle. Color, greenish to yellowish-white. Cleavage very distinct, resembling talcose slate. H.=1·5. Sp. gr. 2·92. Before the blowpipe, in the closed tube, yields water; in the platinum forceps exfoliates slightly, and by prolonged heating, fuses with difficulty on the thin edges. With cobalt solution gives a reaction for alumina.

I received a second specimen, of a similar character, from Dr. F. A. Genth, who has kindly furnished me with several interesting steatitic minerals for examination. Dr. Genth informs me that it was found at Carbonton, Moore Co., North Carolina. It is more distinctly laminated than the specimen from Deep River, and was somewhat whiter in color, and had a density of 2·82.

These minerals have been analyzed, under my direction, in the Sheffield Laboratory of Yale College. No. 1, by Mr. Samuel T. Tyson; No. 2, by Mr. Oscar D. Allen:

	$\dot{S}i$	$\dot{A}l$	$\dot{F}e$	$\dot{H}$	
1. Deep River,	65·93	29·54		5·40	Tyson.
2. Carbonton,	66·25	27·91	1·08	5·25	Allen.

The composition is the same as that of the radiated and compact pyrophyllite, and this new and interesting variety is intermediate between the two extremes of structure. It furnishes additional evidence that the peculiar pyrognostic characters of the lamellar-radiated variety are due entirely to the structure of the mineral. My attention was first called to this substance by Mr. George Munger, of the firm of Dean & Munger, of this city, who have brought it into use extensively in the form of pencils for writing on slates and blackboards, for which purpose it is exceedingly well adapted.

Quartz [p. 145, II, III, IV, VII, VIII].—Rammelsberg has published an interesting series of experiments on the action of caustic potash on different varieties of silicic acid (*Pogg. Ann.*, cxii, 177). He confirms the observation of Fuchs and Rose, that caustic potash very perceptibly attacks quartz, and shows the impossibility of determining the relative amount of amorphous silica in hornstone, agate, chrysoprase, etc., by this means. These minerals consist chiefly of quartz, as H. Rose has already determined; their density, which is generally near 2·6, favors this conclusion. They always contain water, and their density is thereby lessened. Some varieties of chalcedony are dissolved to a great extent in caustic potash, but their specific gravity proves that the quantity of amorphous acid which they contain is much less than that indicated by the amount taken up by the potash solution. A specimen of chalcedony, from Hungary, with a density of 2·567, left, on repeated treatment with potash, a residue which amounted to only 6·12 per cent of the original substance. Opals also were found to differ very much in their solubility; many varieties appeared to contain quartz.

To ascertain the relative amount of quartz and amorphous silicic acid in these substances, Rammelsberg proposes to follow out the suggestion of Fuchs, who showed that when either powdered opal, or artificially prepared silicic acid, were mingled with caustic lime and water, they harden after some months into a sort of cement, which contains a silicate that gelatinizes with acids. Quartz is entirely without action on the lime when thus treated. Rammelsberg also remarks, that the optical properties of these minerals, although of great interest, do not offer a solution of the chemical side of the question.

G. Rose has observed crystallized quartz in the metallic iron of Xiquipilco, in Mexico. The crystal examined was $\frac{1}{3}$ of a line in diameter (*Pogg. Ann.*, cxiii, 184).

Rastolyte.—See Chlorite.

Rhodonite [p. 167, III].—Analysis of rhodonite, from Shäbenholz, near Elbingerode, by H. Hahn:

$\dot{S}i$	$\dot{M}n$	$\dot{C}a$	$\dot{M}g$	$\dot{F}e$	$\dot{A}l$	FeS_2	$\dot{H}$
44·86	42·98	3·06	6·15	1·52	0·74	0·40	0·95=100·65

B. and H. Zeitung, xx, 267.

ROESSLERITE [*R. Blum. Jahresber. d. Wetterauer Gesellsch.*, 1861, 32].—This name has been given by Blum to a new hydrous arseniate of magnesia, from the Kupfershiefer of Bieber. It is found in thin crystalline plates, with a columnar to fibrous structure, and sometimes in vermiform efflorescences. Cleavage, distinct in one direction. H.=2-3. Translucent to opaque; lustre, vitreous to dull. The translucent mineral on exposure loses its vitreous lustre, becomes opaque, dull and white. B.B. fuses to a white enamel, and in the closed tube gives water. Soluble in chlorhydric acid. Analysis by Delffs:

	Ṁg	T̈s	Ḣ
	14·22	40·16	45.62
Oxygen,	5·69	13·97	40·55

giving the formula $\dot{M}g^2\ddot{T}s+15\dot{H}=\dot{M}g$ 13·80, $\ddot{T}s$ 39.65, $\dot{H}$ 46·55=100 00.—*Jahrb. Min.*, 1861, 334.

SCHEELITE [p. 347, VIII].—Analysis of a very pure variety from Traversella, by Bernouilli, gave,

$\dddot{W}$	Ċa		
80·70	19·25	=	99·95

Taking the equivalent of tungsten at 93·4, the formula $\dot{C}a\ \dddot{W}$ requires $\dddot{W}$ 80·74, Ċa 19·26.—(*Pogg. Ann.*, cxi, 607, in Kenngott's *Uebersicht*, 1860, 31.)

SERPENTINE [p. 282, I-IX].—Analysis of *serpentine*, resulting from the alteration of chrysolite, from Webster, North Carolina, gave Genth:

S̈i	Ä̇l	Ḟe	Ṁg	Ṁn	Ṅi	Ċa	Chrome-iron.	Ign.	
43·87	0·31	7·17	38·62	*tr.*	0·27	0·02	0·57	9·55	= 100·88

Dr. Genth remarks, that in the change of chrysolite into talc or serpentine, a portion of the magnesia is eliminated, which separates as brucite, hydromagnesite, magnesite, or dolomite, minerals which occur more or less at the principal serpentine localities. For further observations on *serpentine*, see Dr. Genth's paper in this Journal, [2], xxxiii, 201-203.

G. Servinstein has analyzed a serpentine pseudomorph of phlogopite from Somerville, New York (*Zeitschrift für Chemie und Pharmacie*, 1860, iii, 15).

Sexangulite.—See GALENA.

Spiautrite.—See WURTZITE.

SPINEL [p. 103, II].—F. A. Genth has analyzed the *automolite* from the Canton Mine, Georgia. The crystals are of a deep leek-green color, and a vitreous lustre, and present octahedral, and dodecahedral planes, the latter deeply striated. Composition:

S̈i	Ċu	Ä̇l	F̈e	Ḟe	Ż̇n	Ṁn	Ṁg		
2·37	1·23	53·37	6·68	3·01	30·27	0·20	3·22	=	100·35

(This Journal, [2], xxxiii, 196.)

Stassfurthite.—See BORACITE.

STAUROTIDE [p. 261, III].—This species has been subjected to a critical reëxamination by Rammelsberg (*Pogg. Ann.*, cxiii, 599). He finds that all the varieties examined contain protoxyd of iron, and that most of the iron is in this state; some varieties contained no sesquioxyd, while others contained from 0·88 to 5·21 pr. ct. Ḟe, and from 10·45 to 13·32 Fe. The silica varied from 28·86 to 51·32 pr. ct., and the alumina from 34·30 to 49·19. Specimens from the same locality varied materially in composition. The following varieties were examined:—I. From Massachusetts; occurs in black and brownish-black crystals, rhombic prisms of 129° 44′, with replacement of the acute edges and terminal plane on the obtuse edges, associated with black-mica and albite. The magnet extracted from the powdered mineral a small amount of magnetite. Fragments were translucent-brown, and the powder, yellowish-brown color. Sp. gr.=3·772.—II. St. Gotthardt. This is the well-known variety of brown staurotide, associated with kyanite and a compact variety of mica, which Schafhäutl has called *paragonite*, and which, according to Rammelsberg, is possibly identical with margarodite or damourite. Rammelsberg

remarks that the exact locality of this variety, as well as that under VII, is uncertain. The locality, St. Gotthardt, has been misapplied to this, as also to other minerals, some of which come from portions of Switzerland, very distant from St. Gotthardt; but as the exact locality is doubtful, R. still calls it by this name. Sp. gr. 3·744 (Jacobson).—III. St. Gotthardt. This, although associated with kyanite in a similar manner to the last, has a very different composition. The staurotide crystals frequently enclosed thin blades of kyanite, so that great care was required to obtain pure mineral.—IV. Franconia, New Hampshire. Large crystals, enclosing garnets; color, brown on the edges. G.=3·764.—V. Goldenstein, in Moravia. Brown crystals, in a reddish-brown mica-slate, associated with white or red quartz, with single small garnets. The staurotide resembles the St. Gotthardt variety in translucency, but the crystals are often covered externally with mica. Streak, yellowish brown. G.=3·654–3·66.—VI. Litchfield, Connecticut. Black crystals in mica-slate; streak, brownish-gray. G.=3·622.—VII. Airolo. The same variety as analyzed by Jacobson. Black crystals in a gray mica-slate, associated with brown garnets. Color, in thin pieces, yellowish-gray; and although the magnet takes up nothing from the powdered mineral, still it does not appear to be entirely pure. G.=3·66–3·73 (Jacobson).—VIII. Lisbon, New Hampshire. Pretty large yellowish-brown crystals in a gray mica-slate, with garnets of an amethystine tinge (this locality is known among American mineralogists as Mink-Pond.—G. J. B.). G.=3·413.—IX. Brittany. A twin crystal, with rounded edges. G.=3·527–3·529 (Jacobson).—X. Pitkäranta, Finland. Large crystals in gray mica-slate; the planes are usually covered with glistening scales of mica. Streak, yellowish-gray. G.=3·265.

The following are the results of the analyses:

			$\dot{S}i$	$\dot{A}l$	$\dot{F}e$	Fe	$\dot{M}n$	$\dot{M}g$	Ign.	
A.	1.	Massachusetts,	28·86	49·19	3·20	13·32	1·28	2·24	0·43=	98·52
	2.	Gotthardt,	29·60	48·53	4·25	11·50	0·96	3·12	0·76=	98·72
B.	3.	Gotthardt,	35·05	44·18	5·21	11·48	*tr.*	2·86	0·95=	99·73
	4.	Franconia,	35·36	48·67	2·27	13·05	*tr.*	2·19	0·27=	101·86
	5.	Goldenstein,	35·15	44·02	0·88	12·16	1·41	3·06	1·27=	97·95
	6.	Litchfield, Ct.,	36·92	42·92	1·85	12·80	0·70	2·93	1·00=	98·82
C.	7.	Airolo?	43·26	40·45	2·40	10·92	—·	2·09	0·45=	99·57
D.	8.	Lisbon, N. H.,	49·10	37·70	—·	10·69	*tr.*	1·64	0·68=	99·81
	9.	Brittany,	50·75	34·86	2·86	10·45	*tr.*	1·80	0·38=	101·10
	10.	Pitkäranta,	51·32	34·30	—·	11·01	0·42	2·32	0·59=	99·96

The oxygen ratios are as follows:

	$\dot{R}$	:	$\ddot{R}$	:	$\dot{S}i$	or	$\dot{R}, \ddot{R}$	:	$\dot{S}i$
1.	0·5	:	3	:	1·9		1·84	:	1
2.	0·5	:	3	:	1·9		1·84	:	1
3.	0·5	:	3	:	2·49		1·4	:	1
4.	0·48	:	3	:	2·37		1·5	:	1
5.	0·6	:	3	:	2·65		1·36	:	1
6.	0·6	:	3	:	2·8		1·3	:	1
7.	0·5	:	3	:	3·5		1	:	1
8.	0·5	:	3	:	4·4		0·8	:	1
9.	0·5	:	3	:	4·5		0·8	:	1
10.	0·65	:	3	:	5·0		0·73	:	1

Rammelsberg classifies these under four heads: (A,) including analyses 1, 2; (B,) 3, 4, 5, 6; (C,) 7; (D,) 8, 9, 10; and considers that the results show a relation between the different varieties similar to the isomorphous members of the feldspar group. The general formula may be written, $(\dot{R}, \ddot{R}^3)+\dot{S}i_n$.

Dr. Genth has published, in his "Contributions to Mineralogy," a description and three analyses of the so-called staurotide, from Canton Mine, Geo., (this Journal, xxxiii, 198). It occurs in minute crystals, rarely of $\frac{1}{4}$ of an inch in length, of a yellowish-brown or cinnamon-brown color, apparently right rhombic prisms, similar to those of staurotide, with planes I and *ii*. G. at 27° C.=3·792, associated with copper and lead ores. The mean result of three closely agreeing analyses was,

$\dot{S}i$	$\dot{T}i$	$\dot{A}l$	$\dot{F}e$	$\dot{Z}n$	$\dot{M}n$	$\dot{M}g$	$\dot{C}u$	$\dot{A}g$	Ign.	
28·82	0·84	49·21	9·51	7·13	0·15	3·22	*tr.*		1·47	= 100·35

This, when compared with the above mentioned results of Rammelsberg, show this mineral to be an exceedingly interesting variety of staurotide, in which a portion of the protoxyd of iron is replaced by zinc.

SZAIBELYITE (*K. F. Peters, Ber. Wien. Akad.*, xliv, 143).—Peters has discovered an exceedingly interesting borate in a gray granular limestone from Werksthal

near Retzbanya, to which he gives the name *szaibelyite*. The structure of the limestone somewhat resembles a coral, showing on the fractured surface numerous light colored circular spots surrounded by a dark crust. The hardness of the interior of these spheroidal masses was such that it was scarcely scratched by steel, while the crust was nearly as soft as limestone. Treated with dilute acid, the mass of limestone was dissolved away, leaving numberless needle-like crystals, in some cases attached to the kernels in such a manner, that the author compares them to a pinball. Viewed under the microscope the crystals appeared to belong to either the monoclinic or triclinic systems. With Nicol's prisms, both the needles, and the kernels were biaxial. In these respects the mineral very much resembles *hayesine*. A chemical examination made by Preyss showed that a solution obtained by acting on the needles with strong chlorhydric acid, gave evidence of the presence of boracic acid and magnesia. A further examination made by Peters proved it to be hydrous borate of magnesia and soda with some chlorine, but containing neither lime or alumina. He calls attention to the remarkable analogy between it and hayesine, but suggests also that it may be classed nearer Volger's *parasite* or Rose's *stassfurthite*. If the soda is an unimportant constituent, it may possibly be identical with the latter mineral.

Talc [p. 275, V, IX].—A talc from Webster, Jackson Co., N. C., which Dr. Genth considers the result of the alteration of chrysolite, gave on analysis (this Journal, [2,] xxxiii, 200):

$\dot{S}i$	$\dot{A}l$	$\dot{F}e$	$\dot{N}i$	$\dot{M}g$	$\dot{H}$	
64·44	0·48	1·39	0·23	33·19	0·34	= 100·07

The absence of water is remarkable.

Tetrahedrite [p. 82, I, II, V, IX].—Ch. Mène gives additional analyses of the so-called *fournetite* (Suppl. IX,) in the *Comptes Rendus*, lii, 311, 1,326; also a new locality of the mineral in the Val Godemar (Hautes-Alpes). According to Mène, this variety of gray copper resembles iron-pyrites, except that its color is steel-gray, with greenish reflections. It is amorphous and compact. Mean of three analyses of the Val Godemar mineral, after excluding from 4·7 to 10·10 pr. ct. of quartz:

	Cu	Pb	S	Fe	As	Sb	
G.=4·30	30·80	11·50	21·70	4·50	10·00	21·50	= 100·00

giving the formula $3Cu_2S+2Sb_2S_3+PbS+Fe_2As_3$, while that from Ardillats gave $3Cu_2S+3Sb_2S_3+PbS+FeAs$. Both varieties contained silver; that from Ardillats, 0·05 to 0·21 pr. ct., and from Val Godemar, 0·08 to 0·11 pr. ct.

Texalite.—See Brucite.

Topaz [p. 259, IV].—Analyses of *topaz*, by H. St. Claire Deville (*Comptes Rendus*, lii, 782):

	$\dot{S}i$	$\dot{A}l$	Si	Fl	
1. Saxony,	22·3	54·3	6·5	17·3	= 100·4
2. Brazil,	25·1	53·8	5·8	15·7	= 100·4

Tritomite [p. 319, III].—F. P. Möller has analyzed this mineral in Prof. Bunsen's Laboratory, with following results. G.=4·26: $\dot{S}i$ 15·38, $\dot{S}n$ 0·74, $\dot{T}a\,\dot{Z}r$ 3·63, $\dot{C}e$ 4·48 $\dot{M}n$ 0·49, $\dot{F}e$ 2·27, $\dot{A}l$ 1·61, $\dot{C}e$ 10·66, $\dot{L}a\,\dot{D}i$ 44·05, $\dot{Y}$ 0·42, $\dot{C}a$ 6·41, $\dot{B}a$ 0·19, $\dot{S}r$ 0·71 $\dot{M}g$ 0·16, $\dot{K}$ 2·10, $\dot{N}a$ 0·56, $\dot{H}$ 5·63=99·49

The 3·63 pr. ct. tantalic and zirconic acid was called so with a query, there having been something anomalous in its reactions. These results differ very materially from the earlier analyses by Berlin and Forbes, but great care seems to have been taken in obtaining accurate results, especially in the determination of the state of oxydation of the bases. Müller gives the formula $3\dot{R}^4\dot{S}i+\ddot{R}\,\dot{S}i^3+6\dot{H}$.—*Ann. Chem. Pharm.*, cxx, 241.

Uranite [p. 430, IV.]—Des Cloizeaux has already shown, by optical examination, that *uranite* and *chalcolite* belong to different crystalline systems, uranite being trimetric, while chalcolite is dimetric. Pisani has now re-examined the chemical composition of these two minerals, and finds that the uranite of Autun, when air-

dried, has 12 atoms of water, the amount remaining constant even after months of exposure, while chalcolite, from Cornwall, has but 8 atoms. When uranite is heated to 70° C. it loses 4 atoms of water, but Pisani considers this as constitutional and not as hygroscopic water. Analyses gave,

	$\dot{P}$	$\ddot{U}r$	$\dot{C}a$	$\dot{C}u$	$\dot{H}$	Sand.	
1. Uranite, Autun,	13·4	56·47	5·60	—	20·00	3·20	= 98·67
2. Chalcolite, Cornwall,	14·0	59·67	—	8·50	15·00	0·40	= 97·57

No. 1, excluding sand and calculating up to 100, gives $\dot{P}$ 14·0, $\ddot{U}r$ 59·0, $\dot{C}a$ 5·8, $\dot{H}$ 21·2; No. 2, calculated in the same manner, equals $\dot{P}$ 14·4, $\ddot{U}r$ 61·5, $\dot{C}u$ 8·6, $\dot{H}$ 15·5, giving the formula for uranite, $(\dot{C}a, \ddot{U}r^2)\dot{P}+12\dot{H}$; for chalcolite, $(\dot{C}a, \ddot{U}r^2)\dot{P}+8\dot{H}$, (*Comptes Rendus*, lii, 817).

Wagite.—See CALAMINE.

WHITNEYITE [VII, IX].—Dr. F. A. Genth has published additional analyses of this rare species (this Journal, xxxiii, 191). The specimen examined was furnished by Prof. Booth of the U.S. Mint, and was thought to be from the north shore of Lake Superior. On examination it proved to consist of two minerals, *whitneyite* and *algodonite*. The whitneyite is compact, with a fine grained structure, and a reddish to grayish white color, and no lustre on surfaces of fresh fracture. Scratching developes a strong metallic lustre, and a reddish-white color, but it soon tarnishes. G.=8·246–8·471, the variation probably due to porosity. Hardness a little less than that of fluor. Slightly malleable. Fracture sub-chonchoidal. Analysis:

	As	Cu	Ag	
1.	10·92[a]	87·64	0·19	= 98·75
2.	12·29	87·48	0·04	= 99·81
3.	12·28	87·37	0·03	= 99·68

a Too low.—F. A. G.

The specimen analyzed was not entirely free from algodonite, but gives very nearly the atomic composition, $Cu_{16}As$=As 11·64, Cu 88·36.

[While on a visit to Lake Superior, last summer, I learned from Mr. A. B. Wood that a loose mass of whitneyite, weighing about 15 lbs., had been found on the Pewabic location, about one mile from the village of Hancock, Portage Lake. A specimen of *whitneyite* mixed with *algodonite*, similar to that mentioned by Dr. Genth, is in the Yale College Cabinet, and was received some years since from Prof. Booth, who remarks on the label, that he broke it from a mass weighing 50 lbs. It thus seems that these arsenids of copper must occur in considerable abundance, and although thus far, they have not been found in place, we may hope that explorations will soon give us the exact locality.—G. J. B.]

WOLFRAM [p. 351, I–IV, VIII, IX].—Analyses of *wolfram*, by F. A. Bernouilli (*Pogg. Ann.* cxi, 603, in Kenngott's *Übersicht*, 1860, 93):

	$\ddot{W}$	$\dot{F}e$	$\dot{M}n$	$\dot{C}a$	$\dot{C}b$	
1. Chanteloupe,	75·68	18·77	5·01	0·22	—	= 99·68
2. "	75·75	18·08	5·75	—	0·31	= 99·89
3. Traversella,	75·99	16·29	3·45	4·03	—	= 99·76
4. Zinnwold,	75·15	9·72	13·99	*tr.*	1·10	= 99·96
5. "	76·20	5·60	17·94	—	—	= 99·74
6. "	75·98	18·51	5·02	—	0·52	=100·03
7. "	76·13	18·49	5·10	—	—	= 99·72

Showing that the bases replace each other in all proportions, and that even from the same locality the composition of different specimens may vary.

WOLLASTONITE [p. 156, II].—Analysis of *wollastonite*, from the granular limestone at Auerbach, by W. Hampe:

$\ddot{S}i$	$\dot{C}a$	$\dot{F}e$	$\dot{A}l$	
52·01	46·74	0·93	1·87	= 101·55

B. and H. Zeitung, xx, 267.

WURTZITE [*C. Friedel, Comptes Rendus*, lii, 983].—This new species is from a silver mine near Oruro, in Bolivia. It is a hexagonal sulphid of zinc, isomorphous with *greenockite*. The following are its characters: Color, brownish-black; lustre, vitreous; streak, brown. Before the blowpipe, and with reagents, gives the same reactions as blende. The crystals are double hexagonal pyramids, in some cases showing the faces of the hexagonal prism, which are striated parallel to the base. The angle between the prismatic and pyramidal planes could not be measured with accuracy, but the mean of several measurements gave about 129°; this is near that of the same angle in greenockite (127° 45′). Cleavage, both basic and prismatic. G.=3·98. H.=3·5—4. Composition:

S	Zn	Fe	Pb	Sb	Cu
32·6	55·6	8·0	2·7	0·2	*tr.* = 99·1

The lead and antimony are due to the gangue, the mineral being associated with sulph-antimonid of lead, and the slight excess of sulphur is owing to the presence of a small amount of pyrites, the presence of which was distinguished by a magnifier. The composition is essentially that of blende, while the hexagonal form proves that natural sulphid of zinc is dimorphous, a fact before established in regard to the artificially produced sulphid. It is named in honor of Adolph Wurtz, the distinguished French chemist.

Breithaupt has published in the *Berg und Hüttenmännische Zeitung*, xxi, 98, the fact that two years since he discovered that the radiated blende from Przibram was hexagonal, and he gave it in his lectures the name *spiautrite*. More recently he has found that the radiated blende from Albergaria Velha in Portugal is also hexagonal. —The name *wurtzite* has the priority in publication, and consequently will be used for the hexagonal form of sulphid of zinc.

YTTRO-TANTALITE [p. 359, IV, IX].—Analysis of amorphous brown *yttro-tantalite* from Kararfvet by Chydenius. Ta 56·44, Zn 0·42, Yt 30·43, Ca 2·27, Cu 0·27, Fe 3·27, U 1·19, H 4·83=99·12.—Kenngott's *Uebersicht*, 1860, 93.

ZINCITE [p. 110, II, III, IX].—The new synonym *Ruby-Zinc* has been proposed for this species by F. Alger.—*Proc. Boston Soc. Nat. Hist.*, viii, 145.

ZIRCON [p. 195, IV].—Kokscharow has found that the so-called *engelhardite* from Ilginsk is identical with zircon.—Kopp's *Jahresbericht*, 1860, 756.

NOTE.—As a new edition of the Mineralogy is now in course of preparation, this is the last Supplement which will be issued before its publication.

Sheffield Laboratory, Yale College, June 16th, 1862.

ART. XX.—*On Phosphatic Guano Islands of the Pacific Ocean;** by J. D. HAGUE.

DURING a few years past the attention of scientific men and of agriculturists has been called to some varieties of Phosphatic Guano found on several small islands of the tropical Pacific and imported to this country and to Europe under the name of "American Guano."

The principal ingredient of these guanos is the phosphate of lime, with which is combined in the various sorts more or less

* Much of the chemical investigation of which the results are given in this paper I made in the Sheffield Laboratory of Yale College, the facilities of which were kindly afforded me by my friends, Profs. Brush and Johnson, to whom I am happy to express my thanks for this favor, and for their valuable assistance in the prosecution of my work. Also to my brother, Mr. Arnold Hague, one of their students, my acknowledgments are due for analytical aid. J. D. H.

phosphate of magnesia, sulphate of lime, organic matter and water. They generally contain traces of ammonia with a small percentage of soluble salts, but these, which, without doubt, formed an important part of the guano as it originally existed, have now almost entirely disappeared in consequence of the various changes to which the deposits have been subjected.

The first samples of these guanos were taken from Jarvis' and Baker's Islands in 1855 and sent to the United States for examination, the results of which led in 1858 to the occupation and working of the deposits. The importance and value of these having once become evident, the Pacific, within a few degrees north and south of the equator, was carefully explored and many other islands were visited, on a few of which beds of guano of some extent were discovered.

In the following paper I propose to describe some of these. I shall have reference chiefly to Baker's, Howland's and Jarvis' Islands, on each of which I resided several months for the purpose of studying the character and formation of their deposits. I also spent some months in exploring this region of the Pacific and visiting many other islands, having a small vessel employed especially for that object. In this service, altogether, I was engaged more than two years, from 1859 to 1861 inclusive, in the employ of William H. Webb, Esq., of New York, by whose courtesy I am permitted to publish these results.

These islands are all of coral formation. They are situated near the equator and between the meridians of about 155° and 180° longitude west from Greenwich. They are without fresh water and almost entirely destitute of vegetation, and are the resort of countless thousands of birds whose accumulated ordure and dead bodies have formed extensive deposits.

Baker's Island.—This island possesses the most important of these deposits. It is situated in lat. 0° 13′ north and long. 176° 22′ west from Greenwich. Excepting Howland's Island, forty miles distant, it is very remote from any other land. It presents the usual features of an ordinary coral island. It is surrounded by a fringing reef, which is from 200 to 400 feet wide and slightly elevated above the sea level at low tide. It is about one mile long and two-thirds of a mile wide, trending east and west. The surface is nearly level, the highest point of which is twenty-two feet above the level of the sea, showing some evidences of elevation.*

* The accompanying engraving exhibits a section of the western (lee) beach which

was cut through for a railway. LL is the level of the reef of which the seaward end P is the shore platform or plateau covered at high tides by five and a half feet

Above the crown of the beach there is a sandy ridge which encircles the guano deposit. This marginal ridge is about one hundred feet wide on the lee side of the island, and is there composed of fine sand and small fragments of corals and shells mixed with considerable guano; on the eastern or windward side it is much wider and formed of coarser fragments of corals and shells which, in their arrangement, present the appearance of successive beach formations. This margin is partially covered with a rank growth of long, coarse grass, portulacca, mesembryanthemum, and a few other species of plants.

Encircled by this ridge lies the guano deposit occupying the centre and the greater part of the island. The surface of this deposit is nearly even, but the hard coral bottom which forms its bed has a gradual slope from the borders towards the centre, or, perhaps more properly, from northwest to southeast, giving the guano a variable depth from six inches at the edges to several feet at the deepest part. None of the grass that grows abundantly on the margin is found on the guano, but there are one or two species of portulacca occurring in certain parts, (particularly where the guano is shallowest and driest), and to this is owing the presence of the fine roots and fibres in some of the guano.

The entire deposit presents considerable uniformity in character. Excepting some isolated spots of little extent there is no outer crust, and the guano of the surface differs but little, if any, from that below. There is, however, some variety in the appearance of the guanos of the deep and shallow parts of the deposit. On the northern side it is from six to twelve inches deep; is generally quite dry, and is a dark brown pulverulent substance of rather coarse grain or texture, containing many thread-like roots and fibres and whitish particles, among which Prof. Liebig

of water. From the shore to the edge of the guano deposit G, is from 300 to 400 feet. The perpendicular height from LL to the summit of the sand beach, SS, is twenty-two feet, and the depth of the excavation opposite this highest point is ten feet, the drawing being a little out of proportion.

The dotted line, *ab*, represents an old beach formation which the cut exposed. It consists of large and small coral fragments and shells beneath which the sand lies in compact strata. This formation was evidently once the surface of the island, and may be traced from *a* to *b*, where the guano rests upon it. Above it lies a sandy ridge, SS, a comparatively new beach accumulation rather indistinctly stratified. The highest point of *ab* is fifteen feet above LL, which altitude, in accordance with the commonly accepted theory that the sea-made coral land does does not exceed ten feet in height, would, of itself, be an evidence of elevation and, consequently, to account for the present height of twenty-two feet, it would be necessary to suppose a subsequent subsidence in order to allow SS to accumulate, and finally another elevation of the whole to its present position. It must be observed, however, that the sandy ridge, SS, only prevails at this altitude on the southwestern shore, and probably violent westerly gales and heavy seas have had much to do with its formation. My own observations favor the opinion that the sea-made coral land may reach a greater altitude than ten or twelve feet. During the prevalence of high surf at Jarvis Island I have known seas to wash up the beach with body and force sufficient to carry away plank and spars that were lying on the crown of the beach eighteen feet above the level of the reef.

observed scattered crystals of the phosphate of magnesia and ammonia.* It is closely though not hard packed, and is readily removed by shovels without the aid of picks. In this part of the deposit the portulacca flourishes most.

The guano on the southern side is of reddish color, of finer texture, much damper, and of less specific gravity than that just described. There is much less vegetation in this part of the deposit, and the guano here contains scarce any roots or fibres.

Chemically these varieties do not differ very much. Usually the darker sort contains less water and more organic (vegetable) matter, from which it probably derives its color.

Analyses of these two sorts are given beyond.

Much light may be thrown on the formation of these deposits by the analysis, (I) which follows, showing the composition of recently deposited guano. The sample itself does not represent any considerable part of the existing deposit, but was taken from a locality where large numbers of birds are still accustomed to congregate. It is the dung of the Pelicanus Aquilus, commonly called the Frigate Bird, which of all the birds frequenting the island is the only one whose recent evacuations are of such a consistency that they may conveniently be collected. They contain a large proportion of solid matter, while the evacuations of nearly all the other birds are very thin and watery. It is found in their favorite roosting places, and shows the character of guano before it has long been subjected to the influence of the weather. It is a light and dry substance, consisting of friable grains or fine powder, of a brown color, smelling strongly of ammonia. Of the three following analyses No. I is this freshly deposited guano; No. II is of the light colored guano from the deeper part of the deposit, and No. III of the dark guano from the shallow part.

	I.	II.	III.
Moisture expelled at 212° Fahr.,	10·40	2·92	1·82
Loss by ignition,	36·88	8·32	8·50
Insol. in HCl, (unconsumed by ignition),	·78	...	...
Lime,	22·41	42·74	42·34
Magnesia,	1·46	2·54	2·75
Sulphuric acid,	2·36	1·30	1·24
Phosphoric acid,	21·27	39·70	40·14
Carbonic acid, chlorine and alkalies, undet.,	4·44	2·48	3·21
	100·00	100·00	100·00
Sol. in water remaining after ignition,	3·63		

No. I contained 3·82 per cent of actual ammonia and all contain traces of iron. I also obtained in sample I. a strong reaction for uric acid.

This sample (No. I) resembles Peruvian guano in many respects, and leads to the conclusion that the difference between that and the American guano is mainly owing to circumstances of climate.

* Liebig's Report on Baker and Jarvis Guanos, Aug. 7th, 1860.

In some parts of the deeper deposit a light scale or crust has formed over the surface, which is generally very thin though occasionally hard pieces are found varying from half an inch to an inch in thickness. The thin scale is met with particularly where there is, or has been, any moisture, and, after showers, where pools of water have been standing for some time, such a crust appears on drying. There seems to have been a similar process in the formation of the thicker crust, for it is found only occasionally in places of which the dampness and general appearance indicate that water may have assisted at its formation.

The thinner pieces are found not only on the surface, but in certain localities form strata at various depths, usually about an inch apart, with intermediate layers of guano. These strata seem to have been formed at intervals during the accumulation of the guano deposit each one at some time having itself formed the surface and now marking a period in its age.

Each of the localities where these strata occur, although on opposite sides of the deposit are at the edges and immediately adjoining the marginal ridge already described and from their proximity to the shore it seems possible that these may have been subjected to occasional floods by high seas washing over the crown of the beach.

The following is an analysis of a thick and hard piece of crust found on the surface:—

Loss by ignition (water and little organic matter)	11·7500
Lime	40·93
Magnesia	·74
Phosphoric acid	40·47
Sulphuric acid	5·66
Loss and undetermined	·45
	100·00

The small amount of magnesia and the excess of sulphuric acid are points worthy of notice.

This crust is formed on Baker's Island only to a limited extent, but its existence there and character are interesting when compared with the Jarvis Island deposits, the better part of which is all crust and in which, as Johnson and Leibig have observed, much of the phosphoric acid is combined as the neutral phosphate of lime. The same is true of this crust of Baker's Island.

Before referring to the climate, birds etc. of this island, I will first give some description of Howland's and Jarvis' Islands.

Howland's Island.—About forty miles in a north northwest direction from Baker's, is situated Howland's Island in lat. 0° 51′ north and 176° 32′ west from Greenwich. It is about a mile and a half long by a half mile wide, containing, above the crown of the beach, an area of some 400 acres. The highest point is seventeen feet above the reef and ten or twelve feet above the level of the high tide. It trends N.N.W. and S.S.E. The general

features of the island resemble those of Baker's. Its surface, at least on the western side, is somewhat depressed and much of it is covered by a growth of purslane, grass and other vegetation like that on Baker's Island, but considerably more abundant. Near the centre of the island there are one or two thickets of leafless trees or brushwood, standing eight or ten feet high and occupying an area of several acres. The tops of these trees, in which the birds roost, are apparently quite dead but the lower parts near the roots, show signs of life after every rain. The windward side of the island is formed by a succession of ridges composed of coral debris with some sand and shells, running parallel to the eastern beach, each one of which may, at earlier stages of the island's growth, have successively formed the weather shore. Occasionally among these ridges a sandy bed is met with in which some little guano is mixed. On the lee side there is also a sandy margin of considerable width. Bits of pumice and pieces of driftwood are scattered all over the island's surface.

The main deposit of guano occupies the middle part of the island and stretches, with some interruptions of intervening sand, nearly from the north to the south end. Its surface is even and in many places covered by a thick growth of purslane whose thread-like roots abound in the guano where it grows. The deposit rests on a hard coral bottom and varies in depth from six inches to four feet. The fact, already observed at Baker's, that vegetation flourishes most where the guano is shallow is also quite apparent here and the consequent characteristic difference between the guano of the deep and shallow parts is distinctly marked. The first variety, from the deeper part, is a fine pulverulent substance of reddish brown color, usually a little damp in its native bed and almost quite free from roots or fibers. The latter is of rather coarser texture, quite black and containing many delicate roots and fibers and much vegetable matter. The following analyses exhibit their comparative quality. No. 1 is of the deep part, No. 2 of the shallow part of the deposit.

	No. 1.	No. 2.
Moisture at 212° Fahr.	1·83	4·12
Loss by ignition	8·65	22·63
Insol. in HCl (unconsumed organic) matter	1·95	2·00
Lime	42·	36·90
Magnesia	2·65	1·24
Sulphuric acid	1·33	·58
Phosphoric acid	39·65	30·80
Carb. acid, chlorine and alkalies undeterm'd,	1·94	1·67
	100·00	100·00

It will be seen that the main difference in these samples is in the volatile matters present. Discarding the water and the organic matter, comparative analyses of the *ash* would vary but little.

Some interesting pseudomorphs occur buried in the guano of this island. Coral fragments of various species were found that

had long been covered up under the deposit and in some of which the carbonic acid had been almost entirely replaced by phosphoric acid. In such I have found seventy per cent phosphate of lime. In many others the change was only partial and, on breaking some of these, in the centre was usually found a nucleus or *core* of coral still retaining its original hardness and composition, while the external parts had been changed from carbonate to phosphate which, though soft and friable, still preserved the structure and appearance of the coral.

Jarvis' Island.—Jarvis' Island is situated in lat. 0° 22′ south and long. 159° 58′ west from Greenwich. It is nearly two miles long by one mile wide, trending east and west, and containing about 1000 acres. Like Baker's and Howland's it has the general features of a coral island, but it differs from them essentially in the fact that it once contained a lagoon which has gradually been filled up with sand and detritus, while the whole island has undergone some elevation. It therefore presents a basin-like form, the surface being depressed from the outer edge towards the centre. It is encircled by a fringing reef, or shore platform, about 300 feet wide; from this a gradually sloping beach recedes, the crown of which is from eighteen to twenty-eight feet high, forming a ridge or border, of varying width, which surrounds the island like a wall, from the inshore edge of which the surface of the island is gently depressed.

Within this depression there are other ridges, parallel to the outer one, and old beach lines and water marks, the remaining traces of the waters of the lagoon, marking its gradual decrease and final disappearance.

This flat depressed surface in the centre of the island is about seven or eight feet above the level of the sea. It bears but little vegetation, consisting of long, coarse grass, mesembryanthemum, and portulacca, and that is near the outer edges of the island where the surface is formed of coral sand mixed with more or less guano. In the central and lower parts the surface is composed of the sulphate of lime, and it is on this foundation that the principal deposit of guano rests. This feature of Jarvis' Island is an important one to consider in studying the difference between the guano found on it and that on Baker's Island, for it readily explains the presence, in much of the Jarvis Guano, of the great excess of sulphate of lime, remarked by all who have investigated it, while the unequal mechanical mixture of the guano with the underlying sulphate accounts for the lack of uniformity in different samples.

In examining the foundation of the guano deposit on Baker's or Howland's Islands, by sinking a shaft vertically, the hard conglomerate reef rock is found directly underlying the guano. Resting on this foundation the guano has undergone only such changes as the climate has produced. On Jarvis' Island, however, after sinking through the guano, one first meets with a

stratum of sulphate of lime (sometimes compact and crystalline, sometimes soft and amorphous) frequently two feet thick, beneath which are successive strata of coral sand and shells deposited one above the other in the gradual process by which the lagoon was filled up.*

Of the origin of this sulphate of lime there can hardly be any doubt. As the lagoon was nearly filled up, while, by the gradual elevation of the island, the communication between the outer ocean and the inner lake was constantly becoming less easy, large quantities of sea water must have been evaporated in the basin. By this means deposits would be formed containing common salt, gypsum and other salts found in the waters of the ocean. From these the more soluble parts would gradually be washed out again by the occasional rains, leaving the less soluble sulphate of lime as we find it here.

Some additional light is thrown on this matter by the different parts of the surface, which, though nearly flat, shows some slight variety of level. The higher parts, particularly around the outer edges, are composed chiefly of coral sand, either mixed with or underlying guano. Nearer the centre is a large tract, rather more depressed, forming a shallow basin in which the bulk of the sea water must have been evaporated, and whose surface (now partly covered with guano) is a bed of sulphate of lime, while, further, there is a still lower point, the least elevated of the whole, where the lagoon waters were, without doubt, most recently concentrated. This latter locality is a crescent shaped bed, about 600 feet long by 200 or 300 feet wide, having a surface very slightly depressed from the outer edge towards the middle. Around the borders are incrustations of crystallized gypsum and common salt, ripple marks and similar evidences of the gradually disappearing lake. The whole is composed of a crystalline deposit of sulphate of lime, which, around the borders, as already observed, is mixed with some common salt, while near the centre, where rain water sometimes collects after a heavy shower, the salt is almost entirely washed out, leaving the gypsum by itself. It is closely, but not hard, packed, and is still very wet. By digging 18 or 24 inches down, salt water may generally be found.

These facts help us to understand the varying conditions in which we now find the guano beds, since the most important part, and that from which the importations have thus far come, rests on a bed of sulphate of lime, of an earlier but similar origin to that just described above: a part rests on a coral formation, while still another part, covering a large tract, has been by the action of water mixed with coral mud.

* These horizontal strata were penetrated to a depth of about twenty feet. They were composed chiefly of fine and coarse sand with an occasional stratum of coral fragments and shells.

The first named deposit, lying on the sulphate of lime bed, has a peculiar character. It is covered by, or consists of, a hard crust that is from one-fourth of an inch to an inch and a half in thickness, beneath which lies a stratum of guano varying in depth from one inch to a foot. In many places where the guano was originally shallow the whole is taken up and formed into the hard crust which then lies immediately on the sulphate. This crust, when pure, is snow-white, with an appearance somewhat resembling porcelain, but is usually colored more or less by organic matter. Generally it is very hard, and strongly cohesive, though sometimes friable, and it lies unevenly on the surface in rough fragments that are warped and curved by the heat of the sun. It consists chiefly of phosphoric acid and lime, but, owing to the variable amount of sulphate of lime with which it is mechanically mixed, there is a lack of uniformity in different samples. Hence the percentage of phosphoric acid varies from over 50 per cent to less than 30 per cent.

The phosphoric acid and lime, moreover, are not combined in constant proportions, some existing as bone phosphate, the greater part, doubtless, in most specimens, as the neutral phosphate, and, possibly, a part as the superphosphate.

The following is an analysis of a piece of pure crust. The sample, in question, was a snow-white fragment, containing scarcely any organic matter.

Moisture at 212° Fahr.,	·12
Loss by ignition, (combined water with little organic matter),	9·62
Lime,	38·32
Sulphuric acid,	1·63
Phosphoric acid,	50·04
Undetermined and loss,	·27
	100·00

This presents a somewhat remarkable character. It appears to be a nearly pure di-phosphate of lime. After allowing to the sulphuric acid the requisite amount of lime, there remains enough of the latter to form ninety per cent of the salt $2CaO, HO, PO_5$ leaving an excess of about three per cent of phosphoric acid, which would suggest the possibility that a part of the phosphoric acid and lime may be combined as $CaO, 2HO, PO_5$.

So small an amount of sulphuric acid is also noticeable in a specimen of Jarvis guano which usually contains a large percentage of that acid, but in this case it is owing to the purity of the crust and the absence of mechanically mixed sulphate of lime.

Samples of Jarvis guano have been examined by many chemists, but their results are not always uniform, because, as I have already explained, their samples were *mixtures* of this crust and the underlying guano or gypsum. A number of analyses, made for commercial purposes by Prof. Johnson of New Haven, I find published in a guano pamphlet, issued by Mr. Webb as a trade circular. Prof. Liebig has also published a very complete analy-

sis of Jarvis guano in his "Report on the Guanos of Baker's and Jarvis' Islands, Aug. 7th, 1860."

The following presents some of the results obtained by these two chemists:

	Liebig.	Johnson. Average of four samples.
Lime,	34·839	34·79
Phosphoric acid,	17·601	18·48
Sulphuric acid,	27·021	20·75

In Johnson's samples nearly the whole of the phosphoric acid is combined with the lime as $2CaO, HO, PO_5$, while Liebig finds for the above,

$3CaO, PO_5$,	17·397 per cent.
$2CaO, HO, PO_5$,	16·026 "

The formation of the neutral phosphate in this guano I think may be considered as a result of the action of sea water to which this part of the deposit has been subjected. It will be remembered that in describing the Baker's Island deposit I gave an analysis of a piece of crust found there, in which the phosphoric acid was likewise partly combined as the neutral salt. In that crust was also noticed a much larger percentage of sulphuric acid than is found in the guano from which it was formed; and, further, it was observed that on Baker's Island this crust only occurs in places of which the appearance and position indicate that water (probably from high seas washing over the crown of the beach) assisted at its formation. It seems to me probable, under these circumstances, that sulphates resulting from the evaporation of the sea water have been decomposed, and that the sulphuric acid has united with the lime of the bone phosphate, causing the formation of the di-phosphate of lime.

That this process may have been carried on to a much greater extent at Jarvis' Island, where much of the deposit has evidently long been acted upon by sea water, seems to me beyond a doubt.

A singular feature is presented by this crust in the formation of so-called 'hummocks,' an idea of which may be better obtained from the accompanying cuts than from words. These 'hummocks'

vary in diameter from one to ten inches and in height from half an inch to six or seven inches. The exterior is composed of the hard, phosphatic crust, while within each one, without exception, there is a central mass of soft, amorphous and nearly pure hydrated sulphate of lime. When one of these is cut through ver-

tically the section shows a series of concentric layers above and around this central mass. The exterior is almost pure phosphate, and, proceeding from the outside towards the centre, each successive layer has less phosphate and more sulphate until the central mass is reached, which is almost pure sulphate. It is worthy of note that this hydrated sulphate of lime, which invariably fills the centre of a "hummock," is amorphous and exceedingly fine and soft, even when the underlying gypsum is crystalline. These hummocks are scattered over certain parts of the deposits and occur in close proximity to each other. In these places the deposit is invariably damp, and, usually, beneath each one may be found, mixed with the underlying sulphate, a black, earthy and damp substance containing much phosphate and some carbonate of lime. This black substance was, probably, coral mud, in which, as in the coral pseudomorphs of Howland's, the carbonic acid has been expelled and replaced by phosphoric acid, and this affords the only explanation that I can offer for this remarkable formation, namely, that in the chemical interchange that must have taken place between the soluble salts washed down from the guano on the surface, the sulphate of lime and the coral mud, there may have been an excess of carbonic acid liberated from the latter and replaced by phosphoric acid. The surface guano was probably wet and in a plastic state like thick mud, and the ascending carbonic acid, finding no other means of escape, and exerting an upward force, produced these hummocks, which have since become dry and hard.

In those parts of the crusted deposit where there are no "hummocks" the surface is usually a little higher and the deposit below drier than where the hummocks occur, and this would furnish a reason for their absence, since the hummocks could hardly be formed, as above explained, if the surface, for want of moisture, were not sufficiently plastic and yielding.

Thus this guano has not only been deprived of its ammoniacal salts, uric acid, etc., as have the deposits of Baker's and Howland's, but by its immediate contact with the gypsum has undergone further chemical and physical changes. Probably, too, the direct action of sea water has effected much by bringing together and mixing the guano with the bed on which it lay, and, by occasional inundations, exposing the whole alternately to the action of water and to the intense heat of the sun.* Thus it has been baked into a thick and hard crust whose chemical composition differs materially from the guano in its usual form.

* McKean's and Phœnix Islands, described below, are likewise old lagoons not yet elevated so high as Jarvis's. Their basins are sometimes flooded at high tides by several inches of water. Thus we may suppose that Jarvis, in an earlier stage of the process of elevation, was subjected to occasional floods, keeping in mind the fact before mentioned, that by digging now in the lower parts of the island salt water may be found at no great distance below the surface.

I have said that there was beneath the crust a stratum of guano of variable depth. Frequently it is wanting altogether, the whole being taken up in the crust and lying in immediate contact with the bed of gypsum. Where there is such a layer of guano it is variable in composition, being mixed with more or less sulphate of lime.

It generally contains from sixty to seventy per cent phosphate of lime.

I come now to speak of that part of the Jarvis deposit which rests on a *coral* foundation. This is of limited extent, but is of great interest because of its similarity to the Baker guano. It is about two feet deep; is a dry powder of dark brown color, of rather lighter shade than the Baker guano, owing to the presence of less vegetable matter. It contains very little coral sand mixed with it. The following is an analysis:

Moisture at 212° Fahr.,	5·02
Loss by ignition,	8·45
Lime,	42·17
Magnesia,	1·02
Sulphuric acid,	3·06
Phosphoric acid,	34·01
Carbonic acid,	·81
Insol. residue, (organic matter unconsumed by ignition),	·60
Chlorine, alkalies, iron, etc.,	4·86
	100·00

It is important to observe that while the greater part of the Jarvis guano, as already described, differs materially from the Baker, *this portion* of the Jarvis deposit has almost the same chemical and physical characteristics as the Baker or Howland guano. Resting like that on a coral foundation, it has been exposed only to like influences, while the Jarvis crusted deposit, above described, owes its peculiar character to its contact with the gypsum on which it lies and to the action of the sea water.

This gypsum or sulphate of lime is usually soft and amorphous, sometimes crystalline, and, at a depth of eighteen inches or two feet, occurs in hard, compact, crystalline beds. It is of a light snuff color, and where it underlies guano, is mixed with considerable phosphate of lime, which has been washed down from the surface. Similar deposits of sulphate of lime occur on many other elevated lagoon-islands of the Pacific, some of which I shall allude to below. I have also seen gypsum, of similar character and appearance, which occurs in "pockets" or small depressions in the now elevated portions of the coral reef at Oahu, Sandwich Islands, and doubtless due to the same source, the evaporation of sea water.

Unfortunately for the commercial interests of the Jarvis guano, the earlier cargoes (the first one or two) that were brought thence were selected without the aid of chemical analysis, and those in charge mistaking the gypsum for guano, sent home cargoes, the

greater part of which was far from being worth the expense of transportation. The repetition of this error was promptly guarded against by sending a chemist to the island, but it required a longer time for the reputation of the article in the market to recover from the ill effects of such a mistake.

Climate.—The climate of these three islands is similar and very equable. The trade winds are almost constant, and blow in the summer from east by south to southeast, and, in the winter, from east by north to northeast. From October to February, inclusive, on Baker's, I did not observe a point of southing in the wind, while during the summer months there are long periods during which the wind is invariably from south of east. Calms are rare, especially those of long duration. Westerly winds have seldom been observed, except, occasionally, as light puffs on quiet, calm days. On one or two occasions only, in the winter, at Baker's, have any westerly winds of much force been recorded.

The sky is clear and cloudless. The temperature is exceedingly even, ranging from 76° at sunrise to 88° Fahrenheit at the hottest part of the day in the shade. In the sun at noon it stands between 95° and 100°.

Rain falls in light showers not infrequently. Heavy showers are rare and rainy days are unknown in my experience there. During four winter months at Baker's Island, from October 1, 1859, to February 15, 1860, rain fell twenty-three times, generally occurring in light showers or squalls, at intervals of a week or thereabouts, and a general coincidence between the times of occurrence of these showers and the changes of the moon from phase to phase has been observed, but this regularity is not so great, neither at this or other seasons, but that weeks have passed without a drop of rain.

During these four months the least of these showers, measured by conical rain gauge, amounted to $\frac{5}{1000}$ of an inch on a level, and the greatest on December 19, 1859, was $\frac{258}{1000}$ of one inch. From December 14, 1859, to December 20, 1859, inclusive, there fell $\frac{655}{1000}$ of one inch. The total amount of the four months' rain was 1·840 inches, of which $\frac{855}{1000}$ fell in December.

Although the amount of rain falling in the summer months is much less than that which falls in winter, there are, nevertheless, days in summer on which showers have fallen as heavy as any in the year.

Rain falls most frequently in the night and just before daybreak; sometimes by day, especially if the sky has long been overcast, a rain cloud passes over the island, but I have often observed the remarkable phenomenon of a rain squall approaching the island, and just before reaching it, separating into two parts, one of which passed by on the north, the other on the south side, the cloud having been cleft by the column of heated air rising from the white coral sands.

The position of these islands near the equator and their remoteness from any high land make them favorable places for studying the meteorology of this region. The equatorial current is a matter of great interest. It has a general direction of west southwest, and runs with a great velocity, sometimes exceeding two knots per hour, and, at times, suddenly changing and running quite as rapidly to the eastward.

During the winter months there are days when the swell is very heavy, and the surf breaks violently on the reefs, but in summer there is little or no surf, and especially on the lee side of the island, the water is very smooth. These periods in the winter occur usually at intervals of a few days and prevail during two or three and sometimes more days. In this connection I may allude to the shifting sands at Baker's, which, as I observed there, change their place twice in the year. The western shore of the island trends nearly northeast and southwest; the southern shore east by north. At their junction there is a spit of sand extending out towards the southwest. During the summer the ocean swell, like the wind, comes from the southeast, to the force of which the south side of the island is exposed, while the western side is protected. In consequence the sands of the beach that have been accumulating during the summer on the south side are all washed around the southwest point, and are heaped up on the western side, forming a plateau along the beach two or three hundred feet wide, nearly covering the shore platform, and eight or ten feet deep. With October and November comes the winter swell from northeast, which sweeps along the western shore and from the force of which the south side is in its turn protected. Then the sand begins to travel from the western to the southern side, and after a month or two nothing remains of the great sand plateau but a narrow strip, while on the south side the beach has been extended 200 or 300 feet. This lasts until February or March when the operation is repeated.

Birds, etc.—From fifteen to twenty varieties of birds may be distinguished among those frequenting the island of which the principal are Gannets and Boobies, Frigate Birds, Tropic Birds, Tern, Noddies, Petrels, and some game birds as the Curlew, Snipe and Plover. Of terns there are several varieties. The most numerously represented is what I believe to be the Sterna Hirundo. These frequent the island twice in the year for the purpose of breeding. They rest on the ground, making no nests but selecting tufts of grass, where such may be found, under which to lay their eggs. I have seen acres of ground thus thickly covered by these birds, whose numbers might be told by millions. Between the breeding seasons they diminish considerably in numbers, though they never entirely desert the island. They are expert fishers and venture far out to sea in quest of prey. The Noddies (Sterna stolida) are also very numerous.

They are black birds, somewhat larger than pigeons, with much longer wings. They are very simple and stupid. They burrow holes in the guano in which they live and raise their young, generally inhabiting that part of the deposit which is shallowest and driest. Their numbers seem to be about the same throughout the year. The Gannet and Booby, two closely allied species, (of the genus Sula), are represented by two or three varieties. They are large birds and great devourers of fish which they take very expertly, not only catching those that leap out of water but diving beneath the surface for them. They are very awkward and unwieldy on land, and may be easily overtaken and captured if indeed they attempt to escape at all on the approach of man. They rest on the trees wherever there is opportunity, but on these islands they collect in great groups on the ground where they lay their eggs and raise their young. One variety, not very numerous, has the habit of building up a pile of twigs and sticks, twenty or thirty inches in height, particularly on Howland's where more material of that sort is at hand, on which they make their nest. When frightened these birds disgorge the contents of their stomachs, the capacity of which is sometimes very astonishing. They are gross feeders, and I have often seen one disgorge three or four large flying fish fifteen or eighteen inches in length.

The Frigate Bird (Tachypetes Aquilus) I have already alluded to. It is a large rapacious bird, the tyrant of the feathered community. It lives almost entirely by piracy, forcing other birds to contribute to its support. These frigate birds hover over the island constantly, lying in wait for fishing birds returning from sea to whom they give chase, and the pursued bird only escapes by disgorging its prey, which the pursuer very adroitly catches in the air. They also prey upon flying fish and others that leap from sea to sea, but never dive for fish and rarely even approach the water.

The above are the kinds of birds most numerously represented and to which we owe the existing deposits. When the islands were first occupied they were very numerous but have since been perceptibly decreasing.

Besides these are the Tropic Birds which are found in considerable numbers on Howland's Island, but seldom on Jarvis' or Baker's. They prefer the former because there are large blocks or fragments of beach rock, scattered over the island's surface, under which they burrow out nests for themselves. A service is sometimes required of this bird which may, perhaps, be worthy of notice. A setting bird was taken from her nest and carried to sea by a vessel just leaving the island. On the second day, at sea, a rag, on which was written a message, was attached to the bird's feet, who returned to the nest, bringing with it the intelligence from the departed vessel. This experi-

ment succeeded so well that, subsequently, these birds were carried from Howland's to Baker's Island, (forty miles distant), and, on being liberated there, one after the other, as occasion demanded, brought back messages, proving themselves useful in the absence of other means of communication.

There are several varieties of tern, those described above, however, being the only kinds that are found in very considerable numbers. The game birds, snipe, plover and curlew, frequent the islands in the fall and winter, but I never found any evidence of their breeding there. They do not leave the island in quest of prey but may be seen at low tide picking up their food on the reef which is then almost dry.

Some of the social habits of these birds are worthy of remark. The gannets and boobies usually crowd together in a very exclusive manner; the frigate birds likewise keep themselves distinct from other kinds; the tern appropriate to themselves a certain portion of the island; each family collects in its accustomed roosting place but all in peace and harmony. The feud between the fishing birds and their oppressors, the frigate birds, is only active in the air; if the gannet or booby can but reach the land and plant its feet on the ground the pursuer gives up the chase immediately.

Beside the birds there were but few original inhabitants found upon the islands. Among those I observe several varieties of spiders, at least two of ants, a peculiar species of fly that attaches itself to the larger birds, and the common house fly, which latter, however, may have been recently introduced. They as well as common red ants are exceedingly abundant.

Rats were found on all these islands, especially on Howland's, where they had become astonishingly numerous. It would seem that they had been carried there long ago, as there are no traces of recent shipwreck on the island, and had multiplied extensively. On Jarvis' Island they were much less numerous, and were probably brought by a ship that was wrecked there thirty years since. They subsist on eggs, and also, as I observed on Baker's Island, by sucking the blood of the smaller birds—the tern and noddies; and in this connection I may observe that these smaller kinds of birds, described above, are almost entirely wanting on Howland's, and their absence, I think, may be attributed to the depredations of the rats. These rats of Howland's Island were almost as numerous as the birds. They are of very small size, being hardly larger than a large mouse, and, I think, must have degenerated from their original state in consequence of the change of climate, food and condition of life. They had completely overrun the island, and on its first occupation by men were a great annoyance. For many nights in succession a barrel containing a few oats caught over 100, and I have known over

3,300 to have been killed in one day by a few men employed for the purpose.

A species of small lizard was also found in great numbers on Howland's Island, some specimens of which I had preserved in spirit, but the package containing them was lost on the voyage home.

Remains of former visitors.—There are some interesting traces on this (Howland's) island of former visitors or residents. Excavations and mounds in the centre of the island, among the thickets of brushwood, referred to above, are evidently the work of man. The most extensive of these excavations is several hundred feet long, and about one hundred feet wide, and ten or fifteen feet deep, forming a gully or ditch, on each side of which the sand and gravel is carefully banked up and kept in its place by walls laid up of coral stone, (blocks of beach and reef rock).

The trees themselves may possibly owe their existence here to the originators of these works, for the sides of this gully are covered by a growth of wood which, unless younger than the rest, would show the trees to be of more recent origin than the excavation.

It is said to be of a species called by the natives of the Sandwich Islands "Kou,"* which abounds on many islands of the Pacific. In the same vicinity there are also the remains of what were low, flat mounds of regular shape, formed of gravel and walled up all around, being about a foot high, and just such as I have observed are used by many South Sea Islanders for the foundation and floor of their houses. In another part of the island, near the western beach, some remains of a hut were found, and near by the fragments of a canoe, some pieces of bamboo and a blue bead. Here also was found, buried under a foot of sand, a human skeleton, the greater part of which, on being exposed to the air, crumbled to dust, leaving only two or three bones in condition to be preserved.

On the south end of the island there is a foot-path laid to cross a bed of coral debris or beach accumulations. The edges of the corals being rough, sharp and painful to the feet, the paths seems to have been laid for the convenience of passengers across this end of the island. It is several hundred feet long, made of flat, smooth stones, at convenient distances apart, for stepping from one to the other. They were evidently laid by hand, as they lie in a direction which forms nearly a right angle with the ridges made by the sea. It is probable that the originators of these works were South Sea Islanders. It sometimes happens that they are drifted off to sea by currents in their canoes, and such a party may have been thrown upon this island. No implements or other traces of civilized people have been found.

* Not to be confounded with "Koa," a species of acacia, and quite a different tree. I have seen the Kou alluded to somewhere as a species of *cordia*.

It is not unlikely that the lizards which abound on the inhabited islands of the Pacific were brought here by these people, and the rats, possibly, came from the same source.

Other Islands.—As already observed, the discovery of these deposits of guano, the extent and value of which were at first greatly exaggerated, induced fortune-seeking parties to explore the Pacific in the hope of finding many more of similar character. Under the act of Congress of 1856, granting American protection to the discoverers and occupants, under certain conditions, of such newly found deposits, nearly all the islands found on the charts within ten degrees north or south of the equator and within 150° and 180° W. were represented as possessing deposits of guano, and claimed by parties who evidently knew but little of their true condition.

A list, forty-eight in number, comprising nearly all of these islands, was published in the New York Tribune, in March, 1859, and was copied and discussed by Mr. E. Behm, in his interesting and valuable article, entitled "Das Amerikanische Polynesien," printed in Petermann's *Mittheilungen*, for 1859.

Of these islands, a number of which I have myself examined, it is safe to assert that some, although having a place on the charts, do not really exist, while many are of very doubtful existence; in some cases two or more names are applied to the same island; some are inhabited, others are covered with trees and vegetation, and very few have guano on them.*

* The following is the list referred to. Those named in the first column are islands whose existence and position is well authenticated, and the greater part of which I have myself visited. Those in italics are either known or said to be guano islands. Those marked with an asterisk are inhabited. Some of the islands mentioned in the second column are known certainly to exist, and are described by various navigators, while others are doubtful, but I am unable to add any *positive* information concerning any of them. The existence of those in the third column is considered as highly improbable, at least in the position commonly assigned to them.

I.	II.	III.
Baker's,	Caroline,	Danger, (6° 30′ N., 162° 32′ W.),	Arthur's
Jarvis',	Ann's,	Makin,	Favorite,
Howland's,	Staver's,	Matthew's,	Farmer's,
Malden's,	Flint, (10° 32′ S., 151° 05′ W.)	Barber's.	Sideron's,
Birnie's,	Baumann's,		Flint, (11° 26′ S., 162° 48′ W.)
Phœnix's,	Rogewein's,		Walker's,
Enderbury's,	Gronique,		Sarah Anne,
Christmas,	Frieuhaven,		Samarang,
Clarence,*	Quiro's,		David's.
Duke of York,*	Low,		
Penrhyn's,*	Pescado,		
Rierson's,*	Ganges,		
Humphrey's,*	Frances,		
Danger,* (10° 0′ S., 165° 56′ W.),	Mary Letitia's,		
Palmyra,	Kemin's,		
Sydney,	America,		
Mary's,	Prospect,		
Nassau.			

The following named islands, in particular, have been supposed, erroneously, as regards some of them, to have guano deposits:

		Latitude.	Longitude.
Phœnix Group.	McKean's,	3° 35′ S.,	174° 17′ W.
	Phœnix,	3° 40′ S.,	170° 52′ W.
	Enderbury's,	3° 08′ S.,	174° 14′ W.
	Birnie's,	3° 33′ S.,	171° 33′ W.
	Malden's,	4° 15′ S.,	155° W.
	Johnston's,	16° 53′ N.,	169° 31′ W.
	Christmas,	1° 53′ N.,	157° 32′ W.
	Starve, Starbuck or Hero,	5° 40′ S.,	155° 55′ W.

Of the above those of the Phœnix group are probably the most important. McKean's Island has been occupied since 1858, and several cargoes of guano of good quality have been brought from it to this country. It is a low island, circular in form, not exceeding three-fourths of a mile in diameter. Like Jarvis, it once contained a lagoon though not elevated so high above the sea. Its surface is consequently depressed, and is so much lower than the beach that at high tides the guano deposit is sometimes covered by two feet of water. As at Jarvis, a deposit of sulphate of lime has resulted from the evaporation of sea water in the basin, forming the foundation on which the guano rests; and owing, probably, to frequent inundations, the two have become so intimately mixed that the quality of much of the guano is considerably impaired. The better specimens contain about fifty per cent phosphate of lime mixed with much sulphate of lime. Much of the deposit is covered by a foot of coral mud, which has been spread out over the part adjacent to the beach.

Phœnix's Island is likewise very small, nearly circular, and less than a half mile in diameter. The centre is considerably lower than the beach, which is about eight or ten feet high, and it is often flooded at high tides. I was unable to land on this island, and my opportunities for observation were confined to shipboard. The guano deposit cannot be very extensive though said to be of good quality.

Enderbury's Island is described as an elevated lagoon, about eighteen feet high, three miles long by two and a half broad. It is said to contain deposits of guano, as is also its neighbor, Birnie's Island, of which I am unable to give any positive information, having never visited either.

Malden's is a large island, ten miles long, and said to be about forty feet high. I believe it is an elevated lagoon, but much of the guano deposit lies on the elevated ridge. Specimens which I have examined, though free from sulphate, were much adulterated by coral sand. Excepting McKean's, no cargoes have been brought from these islands just alluded to. From Johnston's Islands one or two cargoes have been brought to this country, the greater part of which proved, I believe, to be sand. These

are described as three small islands (probably islets of one atoll) containing but little guano and that much mixed with coral sand.

Christmas Island is a well-known lagoon thirty miles long, trending east and west, having much vegetation. Much has been said by speculators of its rich deposits, but I have good reason to believe that there is no guano, worthy of mention, on the island. Samples that I have examined were chiefly coral sand.

Starbuck's, Starve or Hero Island is an elevated lagoon, and is worthy of mention because, like Jarvis', McKean's and other islands of similar structure, it contains a large deposit of gypsum. Its supposed guano I have found to consist of the hydrated sulphate of lime, containing about twelve per cent of phosphate of lime and colored by a little organic matter.

So far as my observation extends, all elevated lagoons have similar deposits of gypsum.

As regards the distribution of these phosphatic guano deposits I believe them, in this region of the Pacific, to be confined to latitudes very near the equator where rain is comparatively of rare occurrence. In latitudes more remote from the equator than 4° or 5° heavy rains are frequent, and this circumstance is not only directly unfavorable to the formation of guano deposits but it encourages vegetation, and when an island is covered with trees and bushes, the birds preferring to roost in them, there is no opportunity for the accumulation of guano deposits.

New York, August, 1862.

ART. XXI.—*Contributions from the Sheffield Laboratory of Yale College.*—III. *On Amblygonite from Hebron in Maine;* by GEORGE J. BRUSH.

A FEW weeks since Mr. John M. Blake, Ph.B., late assistant in this Laboratory, called my attention to a peculiar feldspathic looking mineral associated with the *lepidolite* from Hebron, Maine. Mr. Blake found on blowpipe examination that the mineral was extremely fusible, and that it gave a strong reaction for lithia, coloring the flame beautifully crimson. A further examination has shown it to be a phosphate of alumina and lithia, with a considerable amount of fluorine and some water. This composition, together with its physical properties, have led me to refer it to the rare species *amblygonite.*

Lepidolite occurs at Hebron in large masses in a coarse granite, and the *amblygonite* is found imbedded in this lepidolite, associated with albite, quartz, red, green and black tourmaline, and more rarely with cassiterite, and a peculiar compact variety of apatite containing minute prismatic crystals of a hair-brown mineral, which I have not yet been able to obtain in sufficient quantity to determine fully its characters.

The Hebron amblygonite is translucent, and has a white color, sometimes with a tinge of gray or brown. Cleavage equal, and perfect in two directions meeting at an angle of 73°–74° or 106°–107°. Lustre, on cleavage surfaces vitreous to sub-adamantine, and on the uneven fractured surfaces faintly greasy. Specific gravity 3·046. Hardness = 6. A small fragment held in the flame of an ordinary stearine candle fuses readily to an opaque white enamel; fusibility =2 on v. Kobell's scale. Heated in a closed tube, the mineral decrepitates slightly, and gives off traces of moisture; when the flame of a blowpipe is directed on the assay it fuses and acts upon the glass tube, producing a deposit of silica, just above the assay, and at the same time giving off water, which reacts acid, and etches the tube. In the forceps it imparts to the blowpipe flame a pure lithia red color without any traces of yellow; when the assay is moistened with sulphuric acid the flame is colored green on the edges, indicating phosphoric acid. The presence of this last substance was confirmed, by fusing a fragment of the mineral in a closed tube with metallic sodium, forming phosphid of sodium, which on treatment with water, evolved copious fumes, with the characteristic odor of phosphureted hydrogen. With salt of phosphorus it dissolves with effervesence to a clear colorless bead showing the absence of silica. With borax gives a transparent colorless bead in both oxydizing and reducing flame. With soda effervesces, and forms a difficultly fusible mass, which, even after addition of nitre, shows no trace of manganese. Heated with nitrate of cobalt it gives the blue color characteristic of alumina. It is only slightly acted upon by chlorhydric acid, but is readily dissolved by sulphuric acid with evolution of hydrofluoric acid; the solution gives reactions for alumina and phosphoric acid. These characters and reactions are sufficient to prove the identity of the mineral with Breithaupt's amblygonite. The only difference between the Hebron mineral, and the amblygonite from Penig in Saxony, is that the former contains so little soda that it imparts a pure lithia-red color to the flame, while the latter gives a flame tinged with yellow. As soon as I can obtain enough of the mineral for the purpose, I hope to examine the alkalies more minutely, with especial reference to rubidium and cæsium. These two new alkaline metals have been found in comparative abundance in the Hebron Lepidolite by Messrs. O. D. Allen and J. M. Blake of this Laboratory.

It is an exceedingly interesting circumstance that the Hebron mineral should occur associated with other minerals in a manner so perfectly analogous to the Saxon amblygonite, the latter being also found in a coarse granite and frequently imbedded in lepidolite containing quartz and tourmaline. The Hebron amblygonite occurs in irregular masses which in some specimens ap-

pear to be rough prisms of from half an inch to an inch in diameter. One of these gave an angle of 106° to 106° 30′.

Since writing the above, I have discovered amblygonite in specimens of lepidolite from the tourmaline locality at Paris, eight miles from the Hebron locality.

Sheffield Laboratory, Yale College, June 25, 1862.

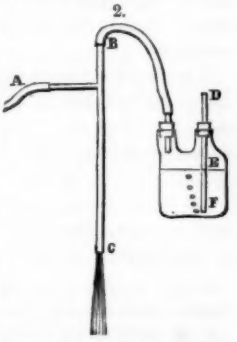
ART. XXII.—*On a Constant Aspirator and Blower;* by M. CAREY LEA, Philadelphia.

VARIOUS modes of producing a blast of air by means of the flow of water have been proposed for laboratory use. A somewhat complicated system involving the use of two fluids, mercury and water, was published in the Philosophical Magazine some years ago, and more recently an application by Dr. Sprengel of the well-known principle of the Catalonian blast furnace was described in this Journal.

It occurred to me that this principle might be made use of for aspirating, as well as for driving, a current of air, and experiment fully confirmed the idea. I have also modified the shape of the arrangement for catching the air described by Dr. Sprengel, introducing the current of water horizontally instead of vertically. I shall first describe the instrument intended for aspirating, and next the complete apparatus for all purposes.

The aspirator is extremely simple. It is nothing more than a tin tube represented by fig. 1, about two feet long, and four-tenths of an inch internal diameter, with a branch three-tenths of an inch in diameter and 4 inches long, inserted horizontally at a distance of four inches from the upper end.

For use, the tube is supported vertically in any convenient manner over a sink. An india-rubber tube communicating with a water-faucet is passed over the end of the smaller horizontal tube A. Another india-rubber tube connects the opening B with the apparatus through which air is to be drawn. As soon as the current of water is established, the air is aspirated. In the figure subjoined, the air enters at D after being aspirated through the Wolfe's bottle, or other apparatus through which it is desired to pass a current of air, enters the tin tube at B, and is drawn through with the water supplied by the pipe A and, escaping at C. The power of this instrument is such that with



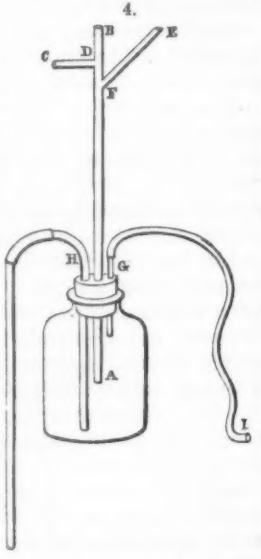
one no larger than here described, a column of water of fifteen inches was easily displaced. The end C may be inserted into the funnel of a Liebig's condenser, and the water employed for cooling may be made at the same time to keep the aspirator in action.*

The aspirating tube (which may also at need replace the blowing tube subsequently to be described) may be easily made by the manipulator himself. A stout cork is bored parallel to its axis and to one side of the centre (not in the middle as in the figure,) and then a smaller hole is made at right angles to the first, communicating with it but not passing further. Three pieces of tube are then fitted into the cork, not allowing either to extend as far in as the junction. The cork is then brushed over with sealing wax dissolved in alcohol.

3.

It is, however, a more convenient plan to construct an apparatus capable of combining both the functions of blowing and aspirating. Such an arrangement is exceedingly useful, and can be made with very little trouble. For this purpose, a tin pipe, A B, about three feet in length and half an inch internal diameter, has two smaller pipes 4 to 6 inches long soldered into it. These are three-tenths of an inch in internal diameter. One, C D, is inserted at right angles, about four inches from the end; the other is inserted about an inch lower, and makes an angle of about 45°. The lower end of the tube passes through the cork of a tolerably wide-mouthed gallon bottle extending rather more than half way down. The tubes may be made of smaller calibre and shorter, even 18 inches answers very well, but the sizes given are those which I have found to afford the best results. The tin pipes can be made by any tinsmith in a few minutes.

4.



Two glass tubes also pass through the cork† of the bottle, a short small tube, G, over the outer end of which an india-rubber tube is passed, and a large tube, H, about half an inch in bore, extending to the bottom of the bottle. Its outer end bends over and is connected by six inches of india-

* This form of aspirator (the tube of glass) has been in use for some time at Sheffield Laboratory in New Haven.—Eds.

† The tube G should extend 6 or 8 inches above the cork, and should not pass below it as represented in the figure.

rubber tube with a straight tube of equal diameter. This last arrangement forms the siphon.

When the apparatus is to drive a blast, an india-rubber tube is connected with a hydrant and attached to the open end of the short horizontal branch of the tin tube. When the water is turned on, the india-rubber tube, G I, is closed for a moment with the finger and thumb. This starts the water through the siphon, and then a continuous and powerful blast of air is driven through the tube, G I, which may be attached to a blow-pipe, a Herapath burner, or be used in any way desired. The main point is this, that the siphon must be capable of carrying off a larger stream of water than that which is allowed to enter: in this way there is never more than an inch or two of water in the bottle, and some air escapes through the siphon, but without stopping its play. Otherwise the bottle may fill up and water be driven through G I. The proper balancing is easily attained and then the apparatus may be put in motion or stopped in a moment, and when in motion goes on indefinitely.

When the apparatus is to be used as an aspirator, the tube I is closed by inserting a glass rod, or passing over it a Mohr's stop-cock. B is closed by a cork and E is connected with the apparatus through which the current of air is to be drawn, or E may be closed and the connection made with B.

The arrangement here described for introducing the air and the water at the upper part of the tube was ascertained, after a number of experiments, to be that which was most effective. When the water is thrown horizontally into the vertical tube, it appears to carry with it a larger volume of air than when introduced perpendicularly or in an inclined position. Although the force of the current of air may be regulated to a considerable extent by diminishing or increasing the stream of water, yet it is to be observed that there must be a certain proportion between the stream of water and the size of the tube; a large tube ceases almost abruptly to produce any air-current when the stream of water is reduced below a certain point, and a small tube will not give an air-current of more than a certain force, no matter how great the stream of water. If it is desired that a single apparatus shall produce all degrees of action, a tin tube, like that before described but a little larger in all its parts, may be provided, with a cork fitting its upper extremity. Through a hole in this cork passes a thick glass rod, or tube sealed at one end, of the same length as the tin tube. The introduction of this cork and rod diminishes the effective calibre of the tube, and enables it to blow or aspirate a gentle current of air with a stream of water which would otherwise have failed to set the apparatus in motion; at the same time it can easily be removed when a powerful air-current is desired. The air in this case is derived wholly from the small inclined tube.

I have found this instrument to be of the greatest utility and convenience; so much so that I have two of them permanently fitted up in my laboratory. One valuable application is for getting rid of poisonous vapors. In any distillation, for example, the recipient or Wolf's bottle may be made to communicate with the open air or with a chimney, a cork with a tube may be inserted into the retort, or an extra tube through the cork of the flask in which the distillation is performed, and the flexible tube, G I, passed over it and a current of air be driven through during the whole operation. Or, if the products of distillation are valuable, the tube may be closed at I by one of Mohr's stop-cocks during the distillation, and at the end a current of air may be passed through the apparatus, sweeping it perfectly clean. In this way I have been able to dissolve oxyd of iridium containing osmic acid, in aqua regia, and drive off the osmic acid without suffering any inconvenience from the latter. The chemist who has once used this arrangement will find it so simple and efficacious that he will be led to employ it when manipulating with substances much less deleterious than osmic acid. It is very convenient in operations where chlorine is to be passed over or through substances, especially where the operation requires to be occasionally interrupted to examine the result.

For driving a blow-pipe, an apparatus of this sort, put together with a bottle and a few pieces of tube, is infinitely more convenient than the most expensive and cumbrous table blow-pipe, fed by a double bellows, especially when it is desired to ignite at high temperatures and for a length of time, the automatic nature of the instrument removing the necessity for working the bellows. A considerable degree of heat is easily obtained. A silver piece was laid on a fragment of brick and the flame of a Herapath burner, fed with a stream of air by this instrument, was turned down upon it: the coin withered up immediately. A similar coin was easily fused to a bright button in a porcelain crucible heated from below. Thick brass wire was melted off in drops, etc.

It is not necessary that the instrument should adjoin the blow-pipe or apparatus for which the air current is wanted. In one of mine, the current produced by the tube A B, two feet long, is carried through tubes about sixteen feet, and might easily be carried further without important loss of power.

The quantity of water required for keeping the apparatus in action depends of course upon the force of the current of air desired, but is never large. In an experimental trial it was found that with a consumption of water of 80 litres per hour, a stream of air amounting to 400 cubic centimetres per minute could be maintained, or in other words, a cubic metre (about a ton) of water would suffice to keep the apparatus in motion for twelve hours. This instrument may be appropriately called an *Æolus*.

Philadelphia, June, 1862.

ART. XXIII.—*Enumeration of the Plants of Dr. Parry's Collection in the Rocky Mountains*, (continued from vol. xxxiii, p. 411); by A. GRAY: with Supplements, by G. ENGELMANN and A. GRAY.

WE are happy to state that Dr. Parry, assisted by Mr. E. Hall, is now again in the Rocky Mountains, and at the last accounts was about to ascend Pike's Peak. An interesting botanical collection may be expected.

222. *Sambucus racemosa*, L. Apparently just the European plant, and a glabrous state of *S. pubens*, Michx.

223. *Symphoricarpus montanus*, H.B.K. New to our flora; well marked by its elongated corolla. *S. glaucescens*, H.B.K., appears, in probably authentic specimens, not to be really different.

224. *Lonicera involucrata*, Banks.

225. *Viburnum pauciflorum*, Pylaie.

226. *Vaccinium cæspitosum*, Michx. Just like the White-Mountain plant. "Strictly alpine."

227. *Vaccinium Myrtillus*, L. var. *microphyllum*, Hook. Fl. Bor. Am. Surely a remarkable variety of *V. Myrtillus*, the flowers as small in proportion as the leaves. According to Dr. Parry, it is the "usual alpine form, growing in closely branched masses, in the shade of stunted evergreens, taking the place of 228, which is found lower down, in pine woods. Fruit small, purplish, without bloom, mild and rather insipid in taste." Dr. Hayden gathered it on the Black Hills of the Platte.

228. *Vaccinium Myrtillus*, var.? The branchlets less strongly angled, and the leaves less reticulated and toothed than in the European *V. Myrtillus*. In the flowers, &c., it is as if intermediate between that species and *V. cæspitosum*. Fuller specimens, and the fruit, are wanted.

229. *Pyrola minor*, L. Collected by Fendler (No. 644) as far south as Santa Fé.

230. *Pyrola chlorantha*, Swartz. Dr. Hooker is right in his suspicion that the Greenland plant of Dr. Kane, referred by Durand to *P. chlorantha*, is *P. grandiflora*; but he is quite wrong, as I think, in referring *P. chlorantha* to *P. rotundifolia*, of which *P. grandiflora* is evidently a mere variety.

231. *Pyrola* (*Moneses*) *uniflora*, L. "In deep pine woods."

232. *Pyrola rotundifolia*, L. var. *uliginosa*. (*P. uliginosa*, Torr.) "In moist, shady woods; flowers rose-color." This is certainly connected with *P. rotundifolia* through *P. asarifolia*. To the synonyms of *P. rotundifolia*, Dr. Hooker might have added *P. occidentalis*, R. Br., *P. bracteata*, Hook., *P. picta*, Hook., &c., but should exclude, as I suppose, both *P. chlorantha* and *P. elliptica*.

233. *Pyrola secunda*, L.

234. *Gaultheria Mirsynites*, Hook. A rare and peculiar plant.

235. *Mimulus luteus*, L. A slender form.

236. *Collinsia parviflora*, Dougl.

237. *Veronica alpinus*, L.

238. *Gerardia aspera*, Benth. Valley of the Platte.

239, 240, 241. *Castilleia pallida*, Kunth. With red bracts, therefore verging to *C. miniata*, Dougl., which I conclude to be only a red-bracted variety of *C. septentrionalis*, Lindl., which is the form of *C. pallida*, with long, well-developed galea. For a revision of the genus, see Supplement III, infra.

242. *Castilleia pallida*, Kunth; nearer the type of the species (*C. Sibirica*, Lindl.) and *C. occidentalis*, Torr.

245. *Castilleia pallida;* the taller and broader-leaved form with longer galea, like the plant of the White Mountains of New Hampshire, *C. septentrionalis*, Lindl.

243. *Castilleia breviflora. Euchroma breviflora*, Nutt. in herb. Acad., Philad.

244. *Castilleia integra*, Gray, l. c.

246. *Castilleia linariifolia*, Benth. The same as Fremont's plant.

247. *Orthocarpus luteus*, Nutt.

248. *Pedicularis racemosa*, Benth. in Hook. Fl., &c. Fine specimens of a rare and interesting species. "Grows in patches near the limit of trees. Leaves dark-green and shining. Flowers yellowish-white. July, August."

249. *Pedicularis bracteosa*, Benth. l. c. "Near the foot of alpine ridges; rare."

250. *Pedicularis Grœnlandica*, Retz. Obs. 4, t. 1. *P. surrecta*, Benth. l. c.; a form with larger flowers and longer beak. Torrey was quite right, as it appears, in referring this plant to *P. Grœnlandica*. Dr. Parry's specimens well accord with the figure of Retz, except that the beak is perhaps a little longer. Bourgeau collected it in the Saskatchawan district with the beak no longer than Bentham states it to be in the Greenland plant. In the Rocky Mountains it is "not uncommon on the borders of subalpine marshes, or of high alpine ridges; in the former stations tall and slender; in the latter shorter and stronger; flowers reddish-purple."

251. *Pedicularis Parryi*, (sp. nov. sect. *Rhyncolophæ*, Bunge, seu *Edentularum*, inter *Unciatas* et *Scapiformes*, Benth.): glaberrima; caule ultra-semipedali subnudo; foliis lineari-lanceolatis pectinato-pinnatipartitis petiolatis, caulinis 1–3 parvulis; segmentis linearibus acutis (ad summum 3 lin. longis) cartilagineo-serrulatis; bracteis parvis trifidis; floribus plurimis breviter pedicellatis in spicam angustam subconfertis; calycis membranacei 5-striati demum subinflati breviter 5-dentati dentibus lanceolatis integerrimis intus lanulosis; corollæ sordide flavæ galea angusta apice incurva sensim in rostrum longiusculum emarginatum haud denticuliferum subdecurvum labium inferius (lobis eroso-crenulatis) multo superantem producta; filamentis glaberrimis. "On alpine ridges. Flowers of a dirty or faded yellow," about half the size of those of the Siberian *P. compacta;* the shape and size of the beak nearly that of *P. ornithorhynca*, which is apparently *P. pedicellata*, Bunge (*P. subunda*, Benth.). Spike naked, 2 to 4 inches long; the lower flowers rather sparse, on pedicels of 1½ to 2 lines in length. The nearest affinity of the species is with *C. compacta*, Bunge, which is larger in all its parts, and

leafy-stemmed, the cauline leaves sessile, their much larger segments pinnatifid or incised, the flowers of the dense spike sessile, the calyx more inflated, the lower lip of the corolla nearly equalling the galea, and two of the filaments slightly bearded.

252. *Pedicularis procera*, (sp. nov. *Bicuspidatarum*): caule 1½–3-pedali crasso foliato superne cum spica densiflora 9–18-pollicari molliter pubescente; foliis glabris pinnatipartitis, (radicalibus sæpe sesquipedalibus pinnatisectis), segmentis lanceolatis laciniato-pinnatifidis, lobis serratis vel incisis; bracteis e basi ovato-lanceolata lineari-elongatis, inferioribus pectinato-pinnatifidis flores superantibus; calyce subæqualiter 5-fido, lobis lanceolatis integris tubo subdimidio brevioribus; corollæ (ultrapollicaris sordidæ virido striatæ) galea apice cucullata erostri truncata bidentata labium sub-patentem breviter trilobum vix æquante. "Shaded hill-sides, not uncommon in scattered localities." Collected also by Fremont in 1845, and in the Sandia Mountains further south, by Dr. J. M. Bigelow; but only in fruit. A striking species, quite distinct from any other known to me.

253. *Pedicularis Sudetica*, Willd., var. "High alpine; rare." The specimens accord very well with *P. Sudetica*, especially with Russian-American specimens, except the deeply emarginate summit of the galea is almost or quite edentulate. Bunge describes them as "breves triangulares basi latos;" but they are often subulate. I fancy that *P. nasuta* of Kamtschatka is very near Dr. Parry's plant. *P. Kanei*, of Durand, from Arctic Greenland, does not belong to *P. Sudetica*, as Dr. Hooker supposed, but to *P. lanata*, Willd.; which again, contrary to Bentham and Dr. Hooker, I must regard with Bunge as clearly different from *P. hirsuta*. It is much nearer another species which Dr. Hooker refers to *P. Sudetica*, viz. *Langsdorffii*, with which it has been confused, but it is perfectly edentulate. The teeth of the latter, however, are inflexed, and so may escape observation. All the continental American "P. hirsuta" I have seen belongs to *P. lanata*. All these species are well discriminated by Bunge in Ledebour's Flora Rossica.

254. *Synthyris plantaginea*, Benth. Wholly below the alpine region. The same as Fendler's No. 582. Radical leaves mostly obtuse or rounded (rarely at all cuneate) at the base; scape multibracteate. Flowers all short-pedicelled; sepals ovate, obtuse, villous-ciliate, becoming nearly glabrous with age. Corolla pale, very deeply 2-parted or even divided, the upper lip cuneate-obovate, entire or obscurely erose, a little exceeding the calyx, twice the length of the 3-lobed lower lip. Stigma capitellate.—The species of the genus need a complete revision, which I am unable now to attempt. In *S. Houghtoniana*, which I formerly had in cultivation, a great diversity was observed in the calyx, (varying from 2–3-parted to 5-parted), corolla, (2–4-parted, as described in the Manual, but the lips or divisions nearly of equal length, the lower not seen very short, as described in the Prodromus), stamens (either two or four), and even the ovary, which is occasionally tricarpellary.

255. *Synthyris alpina*, (sp. nov.): spithamæa; foliis radicalibus ellipticis seu ovalibus nunc subcordatis creberrime crenatis mox glaberrimis; scapo superne folioso-bracteato; spica brevi densa; sepalis lanceolatis extus præsertim ad margines cum bracteis longissime villosis; corolla

bipartita, labio superiori latissimo eroso, inferiori multo minori 2–3-partito, lobis angustis; stigmate capitato. "Growing in crevices of rocks, on the dividing ridge, at the elevation of 10,000 feet. Very different from No. 254, strictly confined to the high alpine region, with glossy foliage and a neat spike of pale blue flowers." Leaves 1½ to 2 inches long, on slender petioles, rather strongly crenate, a little fleshy, very smooth, or early becoming so, as also the lower part of the scape. Bracts on the upper part of the scape ovate or in the spike lanceolate, sessile, and ciliate with very long woolly hairs. Spike only an inch long in flower, very dense, and very woolly; flowers nearly sessile; the corolla larger and more exserted than in *S. plantaginea*. Sepals in flower lanceolate and acute or acutish; but in a fruiting specimen broader and obtuser. Only two stamens seen, which, as in other species, are almost hypogynous.

256. *Chionophila Jamesii*, Benth. "On bare or grassy ridges of the snowy range, July. Flowers pale cream-color." A most interesting rediscovery, enabling us nearly to complete the account of this well-marked genus. The only known original specimen, and a very scanty one, is in the Hookerian herbarium, to which it was contributed by Dr. Torrey, mixed with *Pentstemon Jamesii*, and no specimen is extant in his own herbarium. But I presume that Dr. Parry's excellent specimens are of the same species, notwithstanding the striking discrepancies. The calyx, which gives the character to the genus, is gamophyllous almost to the summit, with 5 broad and short nearly equal teeth, considerably ampliate, thin, membranaceous, or even scarious. Corolla tubular, slightly dilated upwards, *nearly twice the length of the calyx*, and with a sort of *palate to the lower lip very densely bearded*. The original specimen must be in poor condition if this beard was overlooked. *Sterile filament much smaller and shorter than the others*, smooth. Stigma small, obtuse and entire. Radical leaves in the larger specimens 2 or 3 inches long, lanceolate-spatulate. Scape 2 to 4 inches high, *puberulent*. Flowers solitary in the axils of the small floral leaves, on very short and *ebracteolate pedicels*.

257. Vide after 261, 262.

258. *Pentstemon acuminatus*, Dougl. in Bot. Reg. t. 1285, var. *P. nitidus*, Dougl., Benth. *P. Fendleri*, Gray in Pacif. R.R. Rep., 2, p. 168, t. 5. "A wide-spread, variable species, with pale glaucous leaves and palish or bright blue flowers." Bentham describes *P. acuminatus* as with "filamento sterili filiformi glabro." But Lindley, in Bot. Reg., where the species was published, says "apice leviter pilosum, aduncum;" and his figure represents a large state of what I must consider the polymorphous species one form of which I published as *P. Fendleri*, and which is certainly *P. nitidus*. *P. cyananthus*, Hook. Bot. Mag., which in the Botany of the Mexican Boundary I had referred here, is however figured as having hairy anthers, like those of *P. glaber*, and with such a corolla as the latter has, but with narrow sepals. It may be a very well developed form of *P. glaber*, var. *alpinus*.

264. A narrow-leaved variety of the foregoing, clearly of the same species; "from plains east of Denver, with numerous bright blue flowers and narrow linear leaves." Similar specimens from Eureka, Mr. How-

ard, but only a span high, as well as others before me, (among them Geyer's No. 154, and some of Hooker's *P. acuminatus*, var. *minor*, from Carlton House), manifestly connect this species with *P. cæruleus*, Nutt., the oldest of all these names. *P. secundiflorus*, Benth., is another connecting form.

259. *Pentstemon glaber*, Pursh, var. *alpinus*. *P. alpinus*, Torr. in Ann. Lyc., N. Y. Only an alpine form of the next, with more attenuated sepals, the particular shape of which is inconstant in the genus. Dr. Parry remarks: "no doubt a variety of *P. glaber*, being almost exactly a dwarfed representative of that elegant species; and its alpine situation would sufficiently account for its stunted size."

260. *P. glaber*, Pursh, (*P. erianthera*, Fraser, Nutt.) "Common on dry hill-sides along the valley of Clear Creek; a splendid species, its large, brilliant, inflated, blue corolla streaked with reddish-purple stains." The name first published, with a character, ought to be restored for this species; since the anthers are but slightly hairy, in comparison with those of the section *Erianthera*, and are frequently glabrous, except a ciliation or mere denticulation at the margin of the valves. The beard at the top of the sterile filament is sometimes almost wanting, and sometimes sparsely extended downwards. I cannot doubt that the figure of *P. speciosus* in Bot. Reg., t. 1270, represents this species, and, returning to an old opinion in this regard, should reduce that to the present species.

261, 262. *Pentstemon glaucus*, Graham in Edinb. Phil. Jour. July, 1829, p. 348; Lindl. Bot. Reg. t. 1286. "Rather abundant at the foot of alpine ridges, above the limit of trees; the taller specimens from a lower elevation in the valley of Clear Creek. The more common form has pale cream-colored flowers with greenish stripes, and pale green leaves; there is a more rare, purple-flowered variety; both quite bilabiate." Small specimens of this are found in James's collection, mixed with *P. Jamesii*, Benth., and formerly confounded by Dr. Torrey with *P. albidus*,—to both of which they have some resemblance. The species, however, is more allied to *P. gracilis*, Nutt.; but it has a more inflated corolla even than *P. pubescens*, with which Bentham confounded it. The specific name is far from distinctive or good.

257. *Pentstemon humilis*, Nutt. in Herb. Acad. Philad.; apparently a reduced, alpine variety of *P. glaucus*, with shorter and rather less ampliate corolla. Specimens collected at Eureka by Mr. Howard (in herb. Acad. Philad.) ally Dr. Parry's plant with the *P. gracilis*, as figured in the Botanical Magazine. According to Dr. Parry it is: "the common mountain species, growing in tufts on rocky places; flowers bright deep blue; leaves glossy and bright green; plant varying from 3 inches to a foot in height."

263. *Pentstemon procerus*, Dougl. About a span high, and it is seldom very much taller. There was doubtless some mistake in the imposition of this name; but it is surely only a variety of *P. congestus*, with purple-blue flowers.

265. *Pentstemon albidus*, Nutt. A common species of the plains. *P. pumilus*, Nutt., is perhaps an alpine state of this. But Fremont's specimens, referred to *P. pumilus* by Bentham, appear to belong to a

remarkably dwarf and tufted, unpublished species, *P. cæspitosus*, Nutt., which Dr. Parry has detected the present season, and sent in a letter.

266. *Campanula Langsdorffiana*, Fischer.; Trauttv. & Meyer, Fl. Ochot., p. 60. *C. heterodoxa*, Bong. Fl. Sitch., an Vest.? Probably also *C. adscendens*, Vest, as it seems to be more allied, except in the size of the flowers, to *C. uniflora* than to *C. rotundifolia*. The calyx-lobes are linear-subulate from a broad base, nearly equalling the corolla, and more or less toothed. Additional specimens, needed to clear up the species, it is hoped may be obtained this summer. It is said to be "common in moist, grassy places on the borders of Upper Clear Creek. Flowers deeper blue than those of *C. rotundifolia*," far larger than those of the next.

267. *Campanula uniflora*, L.

268. *Campanula rotundifolia*, L.; alpine form, like that of the White Mountains of New Hampshire.

269. *Valeriana dioica*, L. (*V. sylvatica*, Richards., &c.)

270. *Galium boreale*, L.; a small form.

271. *Gilia spicata*, Torr. & Gray, ined. *Elaphocera spicata* and *E. affine*, Nutt. in herb. "Growing, with a deep tap-root, in the deep sandy bottoms of Bijou Creek, east of Denver. Flowers light cream-color or flesh-color; the whole plant exhaling a fœtid smell, like bone-filings."

272. *Phacelia* (*Eutoca*) *sericea*, Gray, Man. "A handsome subalpine."

273. *Cuscuta cuspidata*, Engelm.

274. *Polemonium pulcherrimum*, Hook.; with lobes of the corolla rounder. A form of *P. pulchellum*. "A charming alpine plant, adorning the high slopes with its deep blue, nodding flowers; whole plant beset with resinous glands, exhaling a strong odor of musk."

275. *Polemonium cæruleum*, L. "At lower stations."

276. *Polemonium pulchellum*, Bunge; nearly *P. Richardsonii*, Hook. & Arn. "Growing in shade at the farthest limit of bushy tree growth. Flowers delicate faded blue." The limits of species (if such they be) in this genus are indeterminate.

277. *Ipomœa leptophylla*, Torr. Sand hills of the Platte; a characteristic plant of the plains.

278. *Eritrichium aretioides*, DC. *Myosotis nana*, Torr. in Ann. Lyc. N. Y., vix Vill. "Rooting in granitic sand at the highest elevations of the snowy range; flowers of the richest cærulean blue." In flower, and with a little of last year's fruit, which, if normal, will distinguish this from the European *E. nanum*. The corolla is a little smaller. I suppose it to be *E. aretioides* of Arctic Russian America, &c., the fruit of which is undescribed. This Dr. Hooker regards as an arctic state of *E. villosum*. But the mature nutlets of our plant are perfectly smooth, and naked on the margins of the very obliquely truncate back.

279. *Primula angustifolia*, Torr. in Ann. Lyc. N.Y. "Associated with the last. Flowers dull red, changing to purple." An interesting rediscovery of one of James's plants.

280. *Collomia linearis*, Nutt.

281. *Collomia gracilis*, Dougl.

282. *Gilia pinnatifida*, Nutt. ined. The same as No. 655, Fendler.

283. *Gilia* (*Ipomopsis*) *aggregata*, Spreng. *G. pulchella*, Dougl.

284. *Mertensia alpina*, Don.; a loosely paniculate, branching, evolute variety. "Common in the valley of Clear Creek, on gravelly banks, growing in irregular clumps, 12 to 18 inches high; flowers dull blue, in May and June."*

285. *Mertensia Sibirica*, Don. pro parte. *Pulmonaria Sibirica*, Linn. & Pursh, quoad syn. Gmel. *Lithospermum denticulatum*, Lehm. Asperif. *L. Sibiricum*, Ledeb. Fl. Alt., & Ic. Pl. Fl. Ross. t. 207. *Pulmonaria denticulata*, Roem. & Schult., Cham., &c. *Mertensia dénticulata*, Don., DC., Ledeb. Fl. Ross. *Pulmonaria ciliata*, James, Torr. in Ann. Lyc. N. Y. 2, p. 224. *Mertensia ciliata*, Don., &c. Besides the greater smoothness, which is variable, this is distinguished from *M. paniculata* by the much shorter and blunt segments of the calyx, and the leaves are glaucescent beneath. No doubt the Linnæan name must be restored to this (the *Pulmonaria Sibirica* of Pallas resuming the name of *M. Pallasii*, Don.); for it is clearly the plant of Linnæus, and perhaps Pursh's from Canada (but more probably that is *M. paniculata*), and I suspect that Lehmann described his *Lith. denticulatum* from Siberian specimens. Certainly it is not known from Eastern "North America," unless from Labrador. H. Engelmann gathered it at Bridger's Pass in the Rocky Mountains, but my specimens have *M. paniculata* intermixed. Redowskian specimens from Kamtschatka, distributed by Chamisso, are of the present species. It is, writes Dr. Parry, "the common brook-side *Mertensia*, found everywhere along the margins of ice-cold, dashing streams, up to the snow-line, delighting in situations where its pale foliage and delicate blue flowers are bathed in the spray. It grows to the height of 1½ to 3 feet; the stems succulent, the lower radical leaves large and cordate."

286. *Mertensia paniculata*, Don. A reduced and alpine, glabrate state, with much less acute leaves, of that form of *M. paniculata* which answers to *Pulmonaria lanceolata*, Pursh, and *P. marginata*, Nutt. (*M. marginata*, Don., and *M. lanceolata*, DC.) "Moist, grassy places, on the slopes of alpine ridges; flowers bright *alpine* blue." *M. paniculata* ranges from Hudson's Bay to Lake Superior, New Mexico above Santa Fé (626, Fendler) and northwestward. The foliage, calyxes, &c., vary, as in other species, from smooth or glabrous to hirsute, but the narrow and acute segments of the deeply 5-parted calyx are always hispid-ciliate. It obviously includes *M. corymbosa* and *M. pilosa*, Don., the *Lithospermum corymbosum* of Lehmann. Dr. Hooker has not seized the characters which distinguish the species from the foregoing.

287. *Mertensia alpina*, Don. *Pulmonaria alpina*, Torr. in Ann. Lyc. N. Y. "The small-flowered alpine *Mertensia;* flowers dull blue."

288. *Eritrichium glomeratum*, DC. Very fine specimens. "Common on gravelly hill-sides and rocky places from the foot of the mountains to the upper valleys."

289. *Phacelia circinata*, Jacq.

290. *Echinospermum floribundum*, Lehm. In fruit.

291. *Eritrichium crassisepalum*, Torr. & Gray, in Pacif. R.R. Exped. 2, p. 171. A young state, with broad leaves.

292–294, vacant.

* For a revision of the species of *Mertensia*, see Supplement, IV.

295. *Lithospermum pilosum*, Nutt. ex char. This is Fendler's No. 626 and Wright's 1562.

296. *Heliotropium* (*Euploca*, Nutt.) *convolvulaceum*, Gray.

297. *Paronychia*, n. sp. apparently, "—a single patch only, found rooting in a sandbar on Upper Clear Creek," not in sufficient good condition for description. We look for better specimens this year.

297. *Phlox Hoodii*, Richards, var. foliis rigidioribus vix lanatis. *P. rigida*, Benth.? *P. brevifolia*, Nutt. in Herb. *P. muscoides* and *P. bryoides* of Nuttall both belong to *P. Hoodii*.

299. *Gilia* (*Leptodactylon*) *pungens*, Benth.

300. *Silene acaulis*, L.

301. *Dracocephalum parviflorum*, Nutt. "The only representative of Labiatæ in the mountain region."

302. *Salvia Pitcheri*, Torr. Prairies in Kansas. This must be the *S. elongata* of Dr. Torrey in James's collection. It is intermediate between *S. azurea* and *S. farinacea*,—two Salvias which would seem to be distinct enough.

303. *Scutellaria resinosa*, Torr. in Ann. Lyc. N. Y. Upper Platte.

304. *Gentiana Parryi*, sp. nov., Engelm. in Trans. St. Louis Acad., 2, p. t. 10. "Near the foot of alpine slopes." This is, says Dr. Engelmann, "a very handsome species, growing in tufts, each stem bearing several large, purplish-blue flowers with bifid folds, and enclosed by a pair of boat-shaped bracts. Leaves rounded, fleshy, glaucous. Nearly allied to *G. calycosa* and *G. Menziesii*, which, however, have single flowers, without the calyculate bracts peculiar to our species, and to the Siberian *G. septemfida*, with long folds slit into numerous bristling lobes." *Engelm.* The plant of Kreusfeldt, in Gunnison's Expedition, referred to *G. affinis* in the second volume of the Pacific Railroad Report, is of this species, but with narrower leaves, and Fremont's No. 360 (1845) is a small-leaved form of it, which also occurs in Mr. Howard's collection (Herb. Acad. Philad.), in one instance with a six-lobed corolla.

305. *Gentiana frigida*, Hænke, var. *algida*, Griseb. "Abundant on high alpine slopes, in moist places, growing in small tufts among Grasses and Carices." "Apparently an intermediate form between the European *G. frigida* and the Siberian *G. algida*. Stems lower than in the latter, only 4 or 5 inches high; the leaves narrower; flowers fewer and closely sessile; calyx often partly slit; lobes of the corolla very acute, greenish blue, reddish-brown in the dried state, punctate, the folds truncate and crenate." *Engelm.* This is also in Mr. Howard's collection. New to America, but found as near as Kamtschatka.

306. *Gentiana prostrata*, var. *Americana*, Engelm. l. c. t. 9, fig. 10–15. "A very small form, single or with few horizontal branches, 1–1½ inches high, found with No. 309. Distinguished from the European and Asiatic forms by the small, 4-parted deeply blue flowers, nearly entire folds, and oblong-linear capsule, attenuated at the base into a short stipe. Chamisso collected the same form in Russian Arctic America." *Engelm.*

135. *Gentiana humilis*, Stev., Engelm. l. c. fig. 1–5. *G. Fremontii*, Torr. in Frem. Rep. "Along the moist grassy banks of Upper Clear Creek, with *Polygonum viviparum*, almost hidden among the grass. Whole plant succulent, fragile, of a pale sickly color: flowers greenish

with white folds."—"Many leafy, one-flowered, erect or ascending branches, 2–5 inches high, from the base. Distinguished from the allied species, and especially from *G. prostrata*, by its larger rosulate lower leaves, which, as well as the oblong-linear cauline leaves, are cuspidate and often mucronate. The capsules on the taller branches are more or less exsert, on the lower ones I find them often enclosed, or bursting sideways through the integuments. Siberian specimens are absolutely identical with the Rocky Mountain plant." *Engelm.*

307. *Gentiana acuta*, var. *stricta*, Griseb. "Rather common in shady pine woods and moist places on Upper Clear Creek. In shaded places the leaves are pale-green on both surfaces, broad and mostly obtuse; the flowers very pale-blue; in more open localities the leaves are dark-green above, pale below, narrower, the upper most acute, the flowers darker." "Stems a foot high, leaves 1–1¾ inches long, 3–7 lines (the lower ones) wide. Flowers about ½ inch long, always 5-parted; lobes of calyx very unequal, the two longer and broader ones exceeding the tube of the corolla; lobes of the corolla acutish or almost obtuse, half as long as the tube. From Drummond's northern specimens in Herb. A. Gray, our form is distinguished by the less acute leaves, and especially by the larger calyx. A specimen from Lower Canada in Herb. A. Gray, probably representing Michaux's plant, has very acute leaves, smaller flowers, a more regular 4-parted calyx, and very acute lobes of the corolla. The very nearly allied *G. Amarella* of northern Europe has the corolla much less deeply divided, with quite obtuse lobes." *Engelm.*

309. *Gentiana acuta*, var. *nana*, Engelm. in Transact. St. Louis Acad., 2, t. 9, fig. 6–9. "In the higher alpine regions, together with *G. prostrata*, in masses of *Silene acaulis*." "A diminutive form, 1½–2 inches high; flowers few, smaller; lobes of 4–5-parted corolla obtuse; beard consisting of few distinct fibres." *Engelm.* This, from the obtuse lobes of the corolla, would appear to confirm Dr. Hooker's view that *G. acuta* is a form of *G. Amarella*, represented in Lapland by *G. lingulata*, Ag. Some specimens distributed with No. 309 are the ordinary *G. acuta* in a depauperate form, with acute lobes to the corolla.

308. *Swertia perennis*, L.

310. *Frasera speciosa*, Dougl. "A very strict and small-flowered form, with ternate, linear-lanceolate, 7–9-nerved cauline leaves, and linear elongated lobes of calyx rather exceeding the corolla. Fendler's New Mexican specimens (No. 686) have large and obtuse radical leaves (12–16 inches long, 4–5 inches wide); even the cauline leaves are broadly oval, only the uppermost being lance-linear; the inflorescence is loose, and the flowers much larger. Dr. Parry's plant resembles more the figure in Hooker's flora. The cup uniting the base of the stamens is ciliate on its edge in this species. *Frasera Carolinensis* has large, obovate-spatulate, feather-veined radical leaves. *Engelm.*

311. *Primula Parryi* (sp. nov.): *P. nivalis* formæ eximiæ similis, nisi foliolis involucri subulatis seu linearibus quam pedicelli elongati triplo brevioribus; calyce glanduloso (lobis lato-lanceolatis acutis) tubum corollæ rubræ adæquante; corollæ lobis rotundatis obcordato-bifidis.—Limb of the corolla an inch in diameter. Pedicels one to nearly two inches long. This magnificent Primrose needs to be compared with Ledebour's

P. pycnorhiza (a very rare and little known species from the Caucasus, which, however, seems too like *P. algida*), and it doubtless lies between that species and *P. nivalis:* but it can hardly be referred to either, although possibly, all these species may be found to merge in one. Dr. Parry remarks that "This fine species is quite constantly met with on the borders of alpine streams near the snow line; its knotted fibrous roots matted together, and constantly bathed in ice-cold water. Its usual height about 12 to 18 inches: flowers of a deep *carmine red* (fading to purple), with a slight primrose odor; leaves glossy on the upper surface, pale green. It flowers in July. It must be quite extensively diffused in its peculiar localities, and it is a wonder it has not been found before. In my sketch map I have named one mountain stream *Primrose* Creek, on account of the abundance of this plant."

312. *Dodecatheon Meadia*, L. A slender, few-flowered variety of this polymorphous species.

313. *Androsace septentrionalis*, L. Both alpine and in the valleys.

314. *Phacelia Popei*, Torr. & Gray in Pacific R. R. Rep. 2, p. 172, t. 10. "Whole plant of a brownish-green color, often robust, 8 to 15 inches high."

315. *Eriogonum umbellatum*, Torr. in Ann. Lyc. N. Y., 2, p. 241, & in Sitgreaves, Rep. t. 12. Flowering specimens: flowers bright yellow, as they are in Hayden's and other specimens.

316. The same as 315 in fruit; the perianth changed to pale yellow turning brownish.

318. The same species, apparently, as the two foregoing, but the flowers in the fine and well preserved specimens are obviously white or cream color. Which form is the original of James's collection, I am unable now to determine. Torrey's figure, in Sitgreaves' Expedition is a good one, but there is nothing answering to it in the letter-press. The rays of the umbel are more numerous, slender, and simple in all these specimens than in Hooker's figure of *E. stellatum;* but a Douglasian specimen appears to belong to this species.

317. *Eriogonum flavum*, Nutt.

319. *Eriogonum alatum*, Torr.

320. *Eriogonum annuum*, Nutt.

321. *Eriogonum effusum*, Nutt. Flowers white: those of *E. microtheca*, Nutt., are yellow.

322. *Polygonum tenue*, Michx. Hillsides, near Central City.

323. *Montelia tamariscina*, Gray? male plant.

324. *Euphorbia marginata*, Pursh.

325. *Croton* (*Hendecandra*) *muricatum*, Nutt.

326. *Frœlichia Floridana*, Moq.

327. *Cycloloma platyphyllum*, Moq.

328. *Eurotia lanata*, Moq. *Diotis*, Pursh.

329. *Euphorbia hexagona*, Nutt.

330. *Euphorbia petaloidea*, Engelm.

331. *Solanum rostratum*, Dun. *S. heterandum*, Pursh.

332. *Polygonum viviparum*, L.

333. *Polygonum Bistorta*, L., var. *oblongifolium*, Meisn.

334. *Oxyria digyna*, R. Br. "Common in the alpine region; the specimens collected are from a lower elevation, and are large."

335. *Asclepias verticillata*, L., dwarf form.

336. *Abronia* (*Tripterocalyx*) *cycloptera*, Gray.

337. *Abronia fragrans*, Nutt., figured in the second volume of the Pacific Rail Road Reports.

338. *Acer glabrum*, Torr., var. *A. tripartitum*, Nutt.

339. *Betula alba*, L. var., *glutinosa*, forma *latifolia*, Regel, or nearly.

340. *Alnus viridis*, DC.

341. *Salix glauca*, L. Masc.

342. *Salix cordata*, Muhl.?

343. *Salix reticulata*, L. (*S. sericea*, Pursh.) Alpine.

344. *Salix discolor*, Willd.

345. *Populus tremuloides*, Michx.

346. *Lloydia serotina*, Reich. *Anthericum*, L.

347. *Calochortus venustus*, Benth., ex Torr. The species greatly need revision and diagnosis.

348. *Streptopus amplexifolius*, DC.

349. *Leucocrinum montanum*, Nutt. in Gray, Melanth., p. 110. A rare plant, one of the many which go to demonstrate the futility of an ordinal separation of the *Melanthieæ* from the *Liliaceæ*. Also collected by Mr. Howard. The specimens in both cases not in good state for examination.

350. *Allium cernuum*, Roth.

351. *Zygadenus glaucus*, Nutt.

352. *Corallorhiza innata*, R. Br.

353. *Listera cordata*, R. Br.

354. *Calypso borealis*, Salisb. In spruce woods; not uncommon.

355. *Platanthera obtusata*, Lindl.

356. *Platanthera hyperborea*, Lindl. To this, as I suspected long ago (in Ann. Lyc. N. Y., when endeavoring to distinguish this species from the next), belongs the *Habenaria dilatata* of Hooker's Exot. Fl., t. 95. "Flowers greenish."

357. *Platanthera dilatata*, Lindl. *Orchis dilatata*, Pursh. *Habenaria dilatata*, Gray, in Ann. Lyc. N. Y. "In subalpine swamps." Flowers white. Since my observations upon these two species, made almost thirty years ago, I have often, like other botanists, when superficially examining dried specimens, been tempted to re-unite them. This Dr. Hooker has recently done, in his memoir of Arctic Plants. It is quite as easy to err in combining as in unduly separating species. Having recently examined the two alive, in view of their arrangements for fertilization, (which I may elsewhere describe), I would now state that the structure and disposition of their genitalia and the shape of the gorge of the flower is so different, that, while *P. dilatata* (like its congeners in general) can rarely if ever self-fertilize, *P. hyperborea* readily does so, much in the mannar of *Ophrys apifera* as recently illustrated by Darwin; the former has almost parallel anther-cells, with a narrow stigmatic surface and a sort of trowel-shaped beak between their bases and below, within the narrow gorge, made by the erect position and connivence of the base of the labellum and other petals, are the large and elongated, linear-oblong, viscid discs or glands. In *P. hyperborea* the labellum, spreading from the base, leaves an open gorge, the more exposed stigma is broad and transverse (as figured by

Sir Wm. Hooker in Exot. Fl., t. 95, under the name of *Habenaria dilatata*), the glands are smaller and orbicular, the beak wanting, the anther-cells more divergent, and, from the curvature of the flower, more overhanging, and the stalks of the pollinia very attenuated and weak. Thus disposed, the pollinia very commonly fall out of the anther-cells while the tip of the labellum is still engaged under the point of the upper sepal and petals, or even in the closed buds; and when the labellum is disengaged and becomes recurved, or even before, the pollinia are apt to topple over and fall upon the broad stigma beneath.* That our *P. dilatata* is the *Orchis dilatata* of Pursh I am assured. Our green flowered species should be re-compared with the Iceland *P. hyperborea*, and with this the Iceland *Orchis Kœnigii* (described originally by Retz as with "*labio tripartito*," but referred by Linnæus to *O. hyperborea*, and annexed by Lindley to a probably quite different species from Unalaschka) should be collated.

358. *Juncus castaneus*, Sm.; an alpine form.

359. *Juncus triglumis*, L. With the last.

360. *Juncus arcticus*, var. *gracilis*, Hook.? Alpine; too young.

361. *Juncus Menziesii*, R. Br. ex Hook.

362. *Luzula parviflora*, DC.

392. *Luzula spicata*, DC., var., approaching *L. Peruviana*. Alpine.

363. *Poa alpina*, L.? "At the foot of the snow banks; July."

364. *Munroa squarrosa*, Torr. *Crypsis*, Nutt. Deep sand beds, east of Denver.

365. *Calamagrostis sylvatica*, Trin. "Dry bottoms of Clear Creek; July.

368. A purple variety of the above (nearly *C. purpurascens*, R. Br.), in an older state. "Alpine; August."

366. *Muhlenbergia gracilis*, Trin. *Calycodon montanum*, Nutt. Pl. Gamb., ex Thurber.

367. *Aira cæspitosa*, var. *arctica*, Trin. *Deschampsia brevifolia*, R. Br. Alpine.

369. *Buchlöe dactyloides*, Engelm.; both sexes of the Buffalo-Grass. "Plains of the Platte."

370. *Boutelona oligostachya*, Torr.

371. *Eriocoma cuspidata*, Nutt. *Stipa membranacea*, Pursh.

372. *Aira cæspitosa*, L. "Alpine ridges."

373. *Festuca rubra*, L. Too young; "alpine ridges."

374. *Poa laxa*, Hænke.

375. *Poa nemoralis*, L., or one of the species referable to this. "Alpine ridges."

* Another North American Orchid, which self-fertilizes, and that without the aid of insects, is *Gymnadenia tridentata*. In this the anther-cells dehisce while the flower-bud is still unopened, and some of the packets of pollen (in this species easily separable from their connections) will be found to have reached stigmatic surfaces, here unusually situated; and I have found an abundance of pollen-tubes to be produced, before the flower had opened. Yet the arrangements for the removal of the pollinia by insects are as perfect as in the species which depend upon insect-aid, and while a portion of the pollen-packets fall away at an early period, the rest remain attached in the usual manner. The plant requires, and will well reward, a critical study.

379. *Poa andina*, Nutt. in herb. Acad. Philad. "Upper Clear Creek."
376. *Poa arctica*, R. Br.? (*P. flexuosa*, Wahl.); a form of *P. laxa*? "Alpine ridges."
377. *Trisetum subspicatum*, Beauv. "Alpine ridges."
378. *Bromus Kalmii*, Gray, Man. "S. Clear Creek; July."
380. *Festuca ovina*, L. "Alpine."
381. *Triticum ægilopoides*, Turcz. Perhaps a variety of *T. caninum*, as Ledebour has it. "Alpine."
382. *Phleum alpinum*, L. "Subalpine."
383, 387, 389. *Carex atrata*, L., var. *nigra*, Boott. (*C. nigra*, All.), except that the perigynia are light-colored. From the var. *ovata*, Boott (*C. ovata*, Rudge), they differ in the sessile and crowded spikes.
384. *Carex rigida*, L.
385. *Carex incurva*, Lightf., with a dense, globular head.
386. *Carex capillaris*, L.
388. *Carex aurea*, Nutt.
390. *Carex lanuginosa*, Michx. S. Clear Creek.
391. *Carex festiva*, Dewey. S. Clear Creek.
393. *Carex bromoides*, Schk.? Too young.
394. *Woodsia obtusa*, Torr. "Subalpine."
395. *Cystopteris fragilis*, Bernh.
396. *Allosorus* (*Gymnogramme*) *acrostichoides;* referred by Sir Wm. Hooker to *A. crispus*. "Alpine."
397. *Notochlæna dealbata*, Kunze. Near Idaho.

[Concluding observations in next number.]

ART. XXIV.—*Abstract of a discussion of the Horizontal Component of the Magnetic Force, from observations made at the Girard College Observatory, Philadelphia, in the years* 1840–'41–'42–'43–'44–'45; by A. D. BACHE, LL.D., F.R.S., Mem. Corr. Acad. Sc. Paris, Sup't. U. S. Coast Survey.

PART IV.—*Investigation of the eleven* (*or* ten) *years period and of the disturbances of the horizontal magnetic force.*

IN the full paper, notes of all the changes in the instruments from accidental derangement or otherwise, and of the corrections applied, follow this statement, as an introduction to Table No. I, which contains the recapitulation of the monthly mean readings of the bifilar magnetometer, corrected so as to present a continuous series and with the observed temperatures.

In applying the results, by equations of the form involving the change of temperature and of epoch, the latter changes including the loss of magnetism in the bar and the change of the horizontal force of magnetism, it was found expedient to omit the results of the first year of the series. The remaining four years results gave 16·5 scale divisions for the monthly effect of the change of magnetic horizontal intensity, and of the magnet-

ism of the bar and 1·8 divisions for the effect of one degree of temperature of Fahrenheit's scale.

A new term involving the difference between the square of mean epoch and any single epoch with a coefficient, was found to improve this result giving for the monthly change 17·6 scale divisions, for the effect of one degree of Fahrenheit, 1·62 divisions, and for the coëfficient of the term involving the square 0·31. This gives for the annual progressive change 211·2 scale divisions, and for the effect of one degree of the thermometer, $q = 1{\cdot}62 \times 0{\cdot}0000365 = 0{\cdot}0000591$ in terms of the magnetic moment of the bar. This agrees with the best direct determinations, being those in which the Observatory was alternately heated and cooled.

To test these results a combination of the six warmest months with the six coldest by alternate means was made, beginning with May, 1841, and ending with April, 1845. The result for correction for temperature was 1·3 scale divisions for 1° Fahrenheit, confirming the foregoing. In reducing the observations 1·5 scale divisions has been used as the correction for each degree of Fahrenheit's scale, $q = 0{\cdot}0000548$ in terms of the horizontal force and the observations are reduced to 63°·0 Fahrenheit.

This discrepancy between the results of the direct experiments for the correction of temperature, and those derived from the general discussion of all the observations occurred also in the Toronto observations, in those at Makerstoun, and in those at St. Helena, and has been the subject of comment by General Sabine, Mr. Broun, and Dr. Lamont.

Table No. II, of the full memoir, contains the results in scale divisions after correcting each value of the former table for temperature.

Table No. III gives the resulting monthly means for each year of the whole series from 1840–'41 to 1844–'45 both inclusive.

The corrections for regular progressive changes of readings in the horizontal force, and for certain irregular changes are next carefully studied and appended in Table No. IV which shows the monthly means of the bi-hourly and hourly readings of the bifilar magnetometer referred to 63°·0 Fahrenheit, and corrected for irregularities in the progressive change. The monthly means for each year and for the five years are given in abstract in Table No. V.

The differences in the successive annual means indicate that the progressive change may be assumed to have been uniform from year to year, and, applying the usual method, an annual progressive change of 220 scale divisions is the result.

From a study chiefly of other independent observations, the total annual change of horizontal magnetic force is determined to be 16·5 scale divisions, hence of the 220 scale divisions of

change shown by the observatory bifilar, 203·5 is due to the loss of magnetism of the bar.

Separation of the larger disturbances.—The observations having been referred to a uniform temperature and corrected for progressive change, Peirce's criterion was applied separately to each month. For this purpose a systematic application was made extending over the whole series of observations commencing with the hour 0 and the month of July, next with hour 2 and August followed by hour 4 and September, and so on in regular progression. This process eliminates from the result the diurnal variation and the annual variation of the disturbances themselves. The value for 0^h in July, 1840, was omitted as affected by two very large disturbances. The following table shows the limiting value of difference from the mean (the monthly mean for the respective hour), also the number of observations in each year subjected to the process.

Limits of rejection by Peirce's criterion.

		Divis.		No.
1840–41	excludes	53		241
1841–42		44		312
1842–43		37		309
1843–44		28		313
1844–45		33		313
Mean value		39	Sum.	1488

The limiting value derived from nearly 1500 observations is 39 scale divisions and the separate annual values show plainly the effect of the eleven (ten ?) year period, the year 1843–44 being a minimum year. Certain limits in the adoption of a separating value are allowable and upon trial as to the actual number of disturbances separated, the value 33 scale divisions was finally adopted. Any observation differing 33 divisions or more from its respective monthly mean was therefore marked and excluded from the mean. 33 divisions equals 0·0012 parts of the horizontal force and in the value of the absolute scale it amounts to 0·005. At Toronto the limiting value was 14 divisions = 0·0012 parts of the horizontal force equal to 0·004 in the absolute scale (vol. III of the Toronto Observations).

Table No. VI, of the full memoir, shows the number of observations and the number of the larger disturbances, separated by the value 33, as the limits for each month, year, and the whole period.

The total number of observations is 24,231, and of disturbances, 1,698. The limiting value therefore separates one in every 14·3 observations. At Toronto, one in every 12·5 was marked as a disturbance.

The larger disturbances having been excluded, new monthly means were taken, and the process was repeated several times,

when required, until all readings differing 33 scale divisions or more had been excluded. Table No. VII, of the full memoir, contains the normals thus found, showing the monthly normals of the bi-hourly and hourly readings of the bifilar magnetometer, reduced to a normal temperature, and corrected for irregularity in the progressive change.

Investigation of the 11 *year (ten?) period, as shown in the changes of the amplitude of the solar diurnal variation of the horizontal force.*

The variation in the amplitude of the diurnal motion of the horizontal force is subject to the same inequality of about eleven years as the declination, and the means of investigation will be analogous to those used in part I. of this discussion. For greater convenience, the preceding monthly normals were united into annual means, and the results put into an analytical form, using Bessel's function applicable to periodical phenomena, and determining the numerical quantities by the application of the method of least squares.

Table No. VIII, of the full memoir, shows the regular solar diurnal variation of the horizontal magnetic force for each year of observation, expressed in scale divisions of the instrument.

These numbers being used in the analytical form, a very close coincidence between the computed and observed results is obtained, the differences, using three terms in the equations, being within the uncertainty of the observed values. The probable error of a single representation for a given hour is $\pm 0{\cdot}6$ scale divisions, or $\pm 0{\cdot}00009$ of the absolute force.

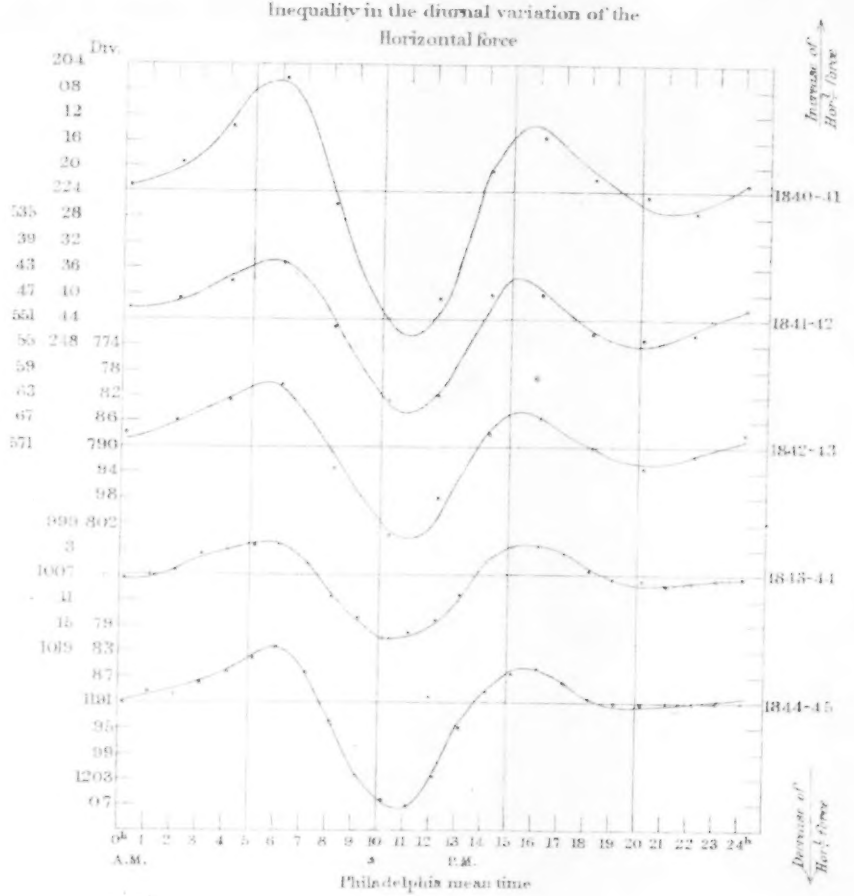
The curves in the accompanying diagram, fig. A, show the results of the corrected means and of the equations. The corrected means are given by dots.

The curves show a double progression in the daily motion, with a principal maximum of horizontal force in the morning, a principal minimum before noon, and a secondary maximum in the afternoon; the precise epochs (to the nearest 5 minutes) and extreme values were computed by means of the preceding formula:

Year.	Principal A.M. max. of horizon. force.		Principal A.M. min. of horizon. force.		Diurnal range in			Secondary P.M. max. of horizon force.		Less than A.M. max. by
July to July.	Epoch.	Amt. Div:	Epoch.	Amt. Div:	Scale Div.	Parts of hor. force.	Value in absolute scale.	Epoch.	Amt. Div:	
	H. M.		H. M.					H. M.		
1840–41	5·45	207·3	11 0	246·1	38·8	0·00142	0·0059	4 05	213·5	6·2
1841–42	5·50	541·7	11 5	565·5	23·8	0 00087	0·0036	3 50	545·1	3·4
1842–43	5·30	779·8	10 55	803·9	24·1	0·00088	0·0037	3 50	784·0	4·2
1843–44	5·40	1001·7	10 50	1016·9	15·2	0·00055	0·0023	4 0	1002·0	0·3
1844–45	5·40	1182 4	10 50	1206·6	24·2	0·00088	0·0037	4 0	1184·8	2·4
Mean,	5·41		10·56				0·0038	3 57		

A

Inequality in the diurnal variation of the Horizontal force



DISCUSSION OF THE MAGNETIC AND METEOROLOGICAL OBSERVATIONS MADE AT THE GIRARD COLLEGE PHILADELPHIA IN 1840 41 42 43 44 & 45

A.D. BACHE. L. L.D. SUPERINTENDENT

DIAGRAMS TO PART IV

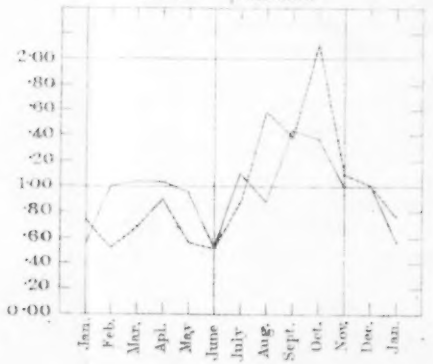
1862

B

Distribution of the number of disturbances in the several months of the year

Full line for Horl. force

Dotted - - - Inclination



The secondary minimum is reached about $8^h\ 30^m$ P. M., with a comparatively small range.

The mean value of the force is attained about $7^h\ 55^m$ A.M., and again about $1^h\ 55^m$ P. M., with considerable regularity; it is again reached at $6\frac{3}{4}^h$, and at $11\frac{1}{2}$ P. M., though with less regularity.

At Toronto (see vol. II. of the Toronto Observations) the diurnal variation of the horizontal force has a principal maximum at a little after 4 P. M., and a principal minimum at 10 or 11 A. M.; the secondary maximum occurs about 6 A. M. There is, therefore, this specific difference in the diurnal motion at these two stations: in that at Philadelphia the morning maximum is the higher of the two, while at Toronto it is the afternoon maximum. The difference between the two maxima, as shown above, is almost nothing in the maximum year 1843–44, but increases before (and after) this epoch in proportion to the interval.

At Toronto the daily range seems to be slightly greater. The secondary minimum at Toronto occurs about 2 or 3 A. M., or about 6 hours later than at Philadelphia; this is a second though less significant point of difference.

The minimum daily range occurs in 1843–44, and is then less than one half of what it was in 1840–41.

The equation for the diurnal range in scale divisions gives the following results:

$$R = +19{\cdot}68 - 3{\cdot}78\ (t-1843) + 2{\cdot}77\ (t-1843)^2$$

it represents the observed values as follows:

	Observed R.	Computed R.
January, 1841.	38·8	38·3
" 1842.	23·8	26·2
" 1843.	24·1	19·7
" 1844.	15·2	18·7
" 1845.	24·2	23·2

The minimum range, as given by the formula, is in September, 1843. In part I of the discussion we found the minimum range of the declination in May, 1843, and the minimum from the disturbances of the declination in August, 1843.

Investigation of the eleven (ten?) year inequality in the disturbances of the horizontal magnetic force.

In table VI the number of disturbances in each month has been given as found from the observations; these numbers are however not directly comparable with one another, first on account of some omissions in the record, and secondly on account of the change from a bi-hourly to an hourly series. For any incomplete month the number of disturbances for the whole month is obtained by simple proportion from the number during

the part of the month recorded; for January, 1841, the total number becomes 35, for June, 1841, the total number is 18. For 1843, January, February and March, the mean total number of disturbances as found in the same months in the preceding and following year was substituted, this mean gave 8, 20, and 20 respectively; the number of disturbances after October, 1843 were halved to make them comparable with the bi-hourly series. There were two anomalous months, July and December, 1840, in which the disturbances amount to 165 and 120 with an annual mean of 64, whereas in the same months in the following year they amount to only 26, and 26 respectively, with an annual mean of 27. The mean annual difference 37 was applied to the numbers found in 1841, which gives 63, and 63 as a substitute for the anomalous values in July and December, 1840. The anomaly does not exist in the phenomenon itself, but is unquestionably due to the irregularity in the progressive change.

Table No. IX, contains the number of disturbances as distributed over the several years and months; all referred to a uniform series of bi-hourly observations. To this table the monthly means and their ratio, when compared with the annual mean, have been added; also, for comparison, the corresponding ratios found in part I. of the discussion of the disturbances of the declination.

MONTH.	1840 1841	1841 1842	1842 1843	1843 1844	1844 1845	Mean.	Hor. force ratio.	Decl. ratio.
July.	(63)	26	24	15	0	26	1·09	0·86
August.	73	17	3	11	2	21	0·89	1·59
September.	54	41	44	16	13	34	1·43*	1·36
October.	68	28	53	2	16	33	1·39	2·12*
November.	49	32	15	0	21	24	1·00	1·08
December.	(63)	26	5	0	23	23	0·97	1·00
January.	35	14	8	1	13	14	0·59	0·77
February.	50	37	20	3	9	24	1·00	0·52
March.	61	25	20	14	2	25	1·06	0·68
April.	48	38	14	8	16	25	1·06	0·91
May.	46	30	25	2	10	23	0·97	0·58
June.	18	16	4	0	28	13	0·55*	0·53
Sums.	628	330	235	72	153	285	12·00	12·00
Mean.	52	28	20	6	13	24		

In the columns of ratios the principal maxima and minima are indicated by an asterisk.

The annual means exhibit plainly the eleven year inequality, they have been represented by the formula:

$$N = +14{\cdot}4 - 10{\cdot}2\,(t-1843) + 4{\cdot}8\,(t-1843)^2$$

	Observed N.	Computed N.
January, 1841	52	54
" 1842	28	29
" 1843	20	14
" 1844	6	9
" 1845	13	13

According to the formula, the minimum occurs in January, 1844.

We have next to consider the eleven year inequality in the magnitude of the disturbances of the horizontal force. Table No. X contains the aggregate amount of the disturbances, expressed in scale divisions, and also their mean amount obtained by application of the number of disturbances already given in table VI.

For reasons already explained, the amount of disturbances in July, 1840, equal to 10761 scale divisions, has been diminished in the ratio of 165 : 63. The ratio of each monthly mean to the mean amount of the year is also given, together with a column of corresponding ratios, derived from the disturbances of the declination as made out in part I. of the discussion.

TABLE No. X.—*Aggregate and mean amount of the disturbances of the horizontal force expressed in Scale divisions.*

MONTH.	1840-41	1841-42	1842-43	1843-44	1844-45	Mean amount.	Hor. force ratio.	Declin. ratio.
July,	(4089)	1157	1295	669	0	56	1·10	0·87
August,	4084	755	131	471	142	52	1·03	1·61
September,	3092	3075	2099	660	1228	56	1·11*	1·56
October,	3720	1284	2399	169	1412	49	0·97	2·06*
November,	2390	1991	915	34	2173	54	1·06	1·06
December,	6515	1225	239	0	2283	52	1·03	1·00
January,	1186	601	0	111	1402	49	0·97	0·72
February,	2664	1822	44	200	806	50	0·99	0 54
March,	3112	1176	39	1412	127	49	0·97	0·66
April,	2138	2075	676	861	1604	49	0·97	0·94
May,	2456	1211	1187	131	789	47	0·93	0·56
June,	560	794	164	0	2390	44	0·87*	0·42*
Mean amount,	53·9	52·0	48·6	46·3	46·8	50·6	1.00	1·00

Maxima and minima in the columns of ratios are marked with an asterisk.

The inequality in the mean amount of the horizontal force disturbances in each year, indicates the year 1843–44 as the minimum year.

From the preceding results, we may assume the month of November, 1843, as the epoch for the minimum of the eleven (ten year ?) inequality, as far as indicated by the differential observations of the horizontal force.

Further Analysis of the Disturbances of the Horizontal Force.

The distribution of the disturbances in number and mean amount over the several months of the year has been given in tables IX and X.

From table IX we learn that the disturbances are greatest in number in September and March, or April, or about the time of the equinoxes, and least in number about January and June, or about the time of the solstices. At the autumnal equinox the

numbers exceed those of the vernal equinox. The same law was found at Toronto. Also, the numbers are smaller at the summer solstice than at the winter solstice, in perfect accordance with the result found at Toronto. These results are shown graphically on the accompanying diagram (fig. B), which contains also the ratio of the disturbances for the declination, in which the same law is apparent.

Table No. X shows that, in reference to the average magnitude of the disturbances, the same law holds good, viz: the greatest relative magnitude occurring about the time of the equinoxes, the greater amount corresponding to the autumnal equinox, and the least to about the time of the solstices, the smaller amount occurring near the summer solstice. The average magnitude of the disturbances of the declination was found subject to the same law.

If we separate the disturbances which increase the force from those which decrease it, we may form the two following tables of the distribution of the disturbances in number and average amount over the several months of the years.

TABLE No. XI—*Annual inequality in the number of disturbances increasing and decreasing the horizontal force.*

	1840-41		1841-42		1842-43		1843-44		1844-45		Sum.		Ratios.	
	Inc.	Dec	Inc.	Dec.	Inc.	Dec.	Inc.	Dec	Inc.	Dec	Inc.	Dec.	Inc.	Dec.
July,	(38)	(25)	6	20	5	19	1	14	0	0	50	78	1·2	1·0
Aug.	18	55	6	11	2	2	2	9	0	2	27	79	0·7	1·0
Sept.	25	29	5	36	38	6	11	5	9	4	88	80	2·1*	1·1
Oct.	18	50	11	17	37	16	1	1	8	8	75	92	1 8	1·2
Nov.	13	36	1	31	4	11	0	0	0	21	18	99	0·4	1·3*
Dec.	(25)	(38)	8	18	0	5	0	0	15	8	48	69	1·1	0·9
Jan.	19	16	6	8	3	5	0	1	3	10	31	40	0·8	0·6
Feb.	15	35	4	33	2	18	0	3	0	9	21	98	0 5	1·2
Mar.	17	44	10	16	3	17	0	14	1	1	31	92	0·8	1·2
April	18	30	14	24	1	13	1	7	0	16	34	90	0·8	1·2
May,	24	22	16	13	10	15	1	1	5	5	56	56	1·3	0·7
June.	9	9	6	10	1	3	0	0	7	21	23	43	0·5*	0·6*
Sum,	239	389	93	237	105	130	17	55	48	105	502	916	12·0	12·0

In each year the number of disturbances increasing the force is less than the number which decrease it; the numbers of increase are to the numbers of decrease as 1 : 1·8. The numbers of the monthly ratio for the increasing disturbances exhibit the same law as found in table No. IX. With respect to the numbers for the decreasing force, the law is apparently less distinctly marked. The maximum seems to occur about two months later (before the winter solstice) at a time when the number for increasing force is apparently at its minimum. This indistinctness in the law may possibly be due to an irregular distribution in reference to the hours of the day, and would probably disappear in a longer series of observations.

TABLE No. XII.—*Annual inequality in the mean amount of the distarbances of the horizontal force. Aggregate amount for increasing and decreasing disturbances expressed in Scale divisions.*

Month.	1840–41.		1841–42.		1842–43.		1843–44.		1844–45.		1840–1845.		Av'ge Amt.		Ratios.	
	Inc.	Dec.	Inc.	Dec.	Inc	Dec.	Inc.	Dec	Inc.	Dec.	Inc.	Dec.	Inc.	Dec.	Inc.	Dec.
July,	(2202)	(1887)	214	943	292	1003	41	628	0	0	2749	4461	55′	57′	1·2	1·1
Aug.	794	3290	261	494	51	80	69	402	0	142	1175	4408	44	54	1·0	1·0
Sept.	1082	2010	186	2889	1857	242	452	208	873	355	4450	5704	45	56	1·0	1·1
Oct.	726	2994	421	863	1685	714	128	41	691	721	3651	5333	44	53	1·0	1·0
Nov.	520	1870	35	1956	185	730	0	34	0	2173	740	6763	41	56	0·9	1·1
Dec.	2204	4311	289	936	0	239	0	0	1483	800	3976	6286	47	56	1·0	1·1
Jan.	723	463	231	370	0	0	0	111	302	1100	1256	2044	48	50	1·1	0·8
Feb.	649	2015	140	1682	0	44	0	200	0	806	789	4747	42	52	1·0	1·0
March,	643	2469	415	761	0	39	0	1412	37	90	1095	4771	39	52	0·9	1·0
April,	732	1406	550	1525	54	622	75	786	41	1563	1452	5902	40	52	1·0	1·0
May,	1000	1456	696	515	412	775	83	48	398	391	2589	3185	42	52	1·0	1·0
June,	307	253	284	510	50	114	0	0	604	1786	1245	2663	44	44	1·0	0·8
Sum,	11,582	24,424	3722	13,444	4586	4602	848	3870	4429	9927	25,167	56,267			12·0	12·0
Number	254	414	93	237	97	92	20	82	96	211	560	1036				
Mean,	46	59	40	57	47	50	42	47	46	47	45	54				

The average amount of a disturbance increasing the horizontal force is 45 scale divisions or 0·0069 in absolute measure; the average amount of a disturbance decreasing the same is 54 scale divisions or 0·0082 in the value of X. The ratio of these numbers is as 1 : 1·2, whereas at Toronto the ratio is 1 : 6·4.

The law of the monthly inequality for amount of increasing or decreasing disturbances is, as in the preceding case, very indistinct and further obscured by the small absolute amount of variation.

In the following table, No. XIII, the larger disturbances have been distributed over the different hours of their occurrence; in this combination the bi-hourly series (of the even hours) of observation has been used throughout.

Hour.	Aggregate amount in scale div'ns.	Number of occurrences.	Average amount.	Ratio of numbers.
0 midnight,	8116	142	57	1·12
2	5967	109	55	0·86
4	4961	93	53	0·73*
6	4751*	94	51	0·74
8	5562	104	53	0·83
10	7721*	146	53	1·15
12 noon,	6825	161	42	1·27*
14	6636	127	52	1·00
16	6634	135	49	1·07
18	6894	132	52	1·05
20	7574	139	55	1·09
22	7358	139	53	1·09

Directing our attention to the columns of aggregate amount and of ratios of number of occurrence, we find a principal maximum about 11 A. M., which seems to correspond to the *secondary* maximum of corresponding ratios at Toronto, occurring about three hours earlier; the principal minimum occurs about 5 A. M.,

which corresponds to the secondary minimum at Toronto, occurring between 5 and 6 A. M.; again at Philadelphia the secondary maximum at midnight is about two hours earlier than the *principal* maximum at Toronto, and the secondary minimum about 4 P. M. corresponds in time to the *principal* minimum at Toronto, occurring between 2 and 6 P. M. Thus the curves at the two stations representing the diurnal variation of the disturbances (irrespective of increase or decrease) of the horizontal force is double crested with an exchange of the principal and secondary maximum and also of the principal and secondary minimum.

In the next table, No. XIV, the diurnal variation of the disturbances is exhibited separately, for disturbances increasing, and disturbances decreasing the horizontal force.

Hour.	Disturb. increasing h. f.			Disturb. decreasing h. f.			Excess of aggregate decrease over aggregate increase.
	Number of occur.	Aggregate amount.	Ratio.	Number of occur.	Aggregate amount.	Ratio.	
0 midnight,	57	2878	1·28	85	5238	1·21	2360
2	44	2173	0·97	65	3794	0·87	1621
4	42	1998	0·89	51	2963*	0·68	965
6	28	1213*	0·54	66	3538	0·81	2325
8	48	2345	1·04	56	3217	0·74	872
10	61	2732	1·22	85	4989	1·15	2257
12 noon,	74	3134*	1·39	87	3691	0·85	557
14	48	2239	1·00	79	4397	1·01	2158
16	49	2200	0·98	86	4434	1·03	2234
18	45	2005	0·89	87	4889	1·13	2884
20	39	1758	0·78	100	5816*	1·34	4058
22	50	2296	1·02	89	5062	1·18	2766
Sums,	585	26971	12·00	936	52028	12·00	25057

The disturbances increasing and those decreasing the horizontal force evidently follow different laws; at Toronto they were found completely opposed; they are less so at Philadelphia. The principal maximum of increasing disturbances (at noon) seems to be cotemporaneous with a secondary minimum of the decreasing disturbances; again the principal maximum of the decreasing disturbances (at 8 P. M.) corresponds to a secondary minimum of the increasing disturbances. In reference to the main feature, the maximum disturbance of those increasing the force and of those decreasing the force, the Philadelphia ratios show even a greater resemblance to the results at St. Helena and the Cape of Good Hope than to those at Toronto. At the two southern stations, the maximum in the disturbances which increase occurs at 11 A. M., and the maximum in the disturbances which decrease occurs about 6 or 7 P. M. (See vol. II, of the St. Helena Observations.)

Table XIV contains also the hourly excess of the aggregate amount of the disturbances which decrease the horizontal force over those which increase the same. If we divide the numbers

by the whole number of days of observation, (nearly 1,500), we obtain the diurnal disturbance variation expressed in scale divisions.

TABLE XV.—*Diurnal disturbance variation.*

	s. d.	In value of absolute scale		s. d.	In value of absolute scale
0h midnight,	1·6	0·00024	12 noon,	0·4	0·00006
2	1·1	17	14	1·4	21
4	0·7	11	16	1·5	23
6	1·6	24	18	2·0	30
8	0 6	09	20	2 8	43
10	1·5	23	22	1·9	29

The average amount by which the disturbances tend to decrease the diurnal variation of the horizontal force is 1·4 scale divisions or 0·00021 in the absolute scale. The maximum effect takes place at 8 P. M., at exactly the same hour when the declination disturbances reach their greatest effect.

In the preceding tables, Nos. XIII, XIV and XV, to the hours indicated, 21½ minutes should be added, the observations being made so much later than the even hours. The preceding discussion shows that for two stations, even at a comparatively short distance, as for Philadelphia and Toronto, there are generally speaking some close coincidences in the laws derived from independent observations; but there are also certain differences in other results; yet it must not be forgotten that for a strict comparability we require, if not simultaneous observations, at least observations extending over similar parts or the whole of an eleven year period. The Philadelphia series includes a minimum year of that inequality with the greater extent of observations before that epoch, whereas at Toronto the series begins after the minimum epoch, and barely extends to a maximum year.

For the purpose of obtaining a better view of the absolute amount of the disturbances and their frequency of occurrence,*

* A table analogous to that given above, showing the distribution of the disturbances in *declination*, is here added for comparison:

Limits adopted. In scale divis.	In minutes of arc.	Number of disturbances.
8 to 16	3·6 to 7·2	1856
16 " 24	7 2 " 10·8	333
24 " 32	10·8 " 14·4	105
32 " 40	14·4 " 18·1	42
40 " 48	18·1 " 21·7	16
48 " 56	21·7 " 25·3	2
56 " 64	25·3 " 29·0	2
64 " 72	29·0 " 32·6	1
beyond		0

they were classified in nine groups of equal differences of 20 scale divisions; the number of disturbances in each was found as follows:

Limits adopted. In scale divisions.	In parts of hor. force.	In the abso. scale.	Number of disturbances.
33 to 53	0·0012 to 0·0019	0·005 to 0·008	1159
53 " 73	19 " 27	08 " 11	348
73 " 93	27 " 34	11 " 14	93
93 " 113	34 " 41	14 " 17	45
113 " 133	41 " 48	17 " 20	27
133 " 153	48 " 55	20 " 23	14
153 " 173	55 " 62	23 " 26	4
173 " 193	62 " 70	26 " 29	6
193 " 213	0·0070 " 0·0077	0·029 " 0·032	2
Beyond,			0

The numbers in the last column cannot be considered as entirely independent of the eleven year period, and in attempting to apply the theory of probabilities in reference to the number of disturbances which ought to occur between the assigned limits, it became apparent that the larger disturbances greatly preponderated, a fact no doubt intimately connected with the difficulty in correctly allowing for the progressive change during the first year of observation.

SCIENTIFIC INTELLIGENCE.

I. PHYSICS AND CHEMISTRY.

PHYSICS —

1. *The Saltness of the Sea:* FORCHHAMMER.—In the course of the last twenty years this distinguished geologist and chemist has executed about two hundred complete analyses of water from all parts of the ocean, but in particular from the Atlantic and the north European seas connected with it. At the eighth meeting of the Scandinavian naturalists, at Copenhagen, in 1860, the important results of these laborious researches were communicated.*

(1.) *Saltness of the Ocean.*—The mean of 140 complete analyses gives 34·304 of salt in one thousand parts of water, unequally distributed over 16 regions. But the specimens being principally taken at lower latitudes, this mean is too high. If we take 34 in one thousand parts as the mean saltness of the sea at the mean atmospheric pressure, and give the results in differences of ten thousandths from this mean, they will become more perspicuous.

Thus the mean saltness of the Atlantic (35.77 thousandth) is expressed by +17.7; of the Californian Pacific +12.2, Japanese Pacific +4.3, Indian Ocean +1.3. These numbers confirm the conclusion of *Lenz* (Pogg.

* Forhandlinger ved de Skandinaviske Naturforskeres VIII Möde, Kjöbenhavn, Juli 1860. Kjöb. 1861, p. 26.

The full detail of the Analyses is: Videnskabernes Selskabs Skrifter, V Række, 1860.

Ann. xx, 73). The Atlantic system of rivers drains by far the greater portion of the continents and has the same position in latitude; thus the evaporation in the Atlantic must be greater than in any other part of the Ocean.

The Atlantic is divided into five regions, viz:

Reg.	III, Arctic region,	mean of	16	analyses,	+15.6
"	II, North temperate,	" "	24	"	+19.5
"	I, " tropical,	" "	14	"	+21.7
"	X, South "	" "	6	"	+24.7
"	XI, " temperate,	" "	6	"	+10.4
"	XVI, Antarctic Ocean,	" "	1	"	−54.2

Thus the tropical part of the Atlantic is the saltest, and the amount of salt regularly decreases toward the poles; yet the northern Atlantic is more salt than the southern (an influence of the Gulf Stream).*

The first great circulation of terrestrial water is represented in these numbers: only a part of the water evaporated between the tropics directly returns to land and sea in form of rain; another part is carried to the polar regions, here condensed to snow and ice, returning toward the equatorial belt either in great fresh-water currents or in veritable ice-streams, thus re-establishing the equilibrium.

(2.) *Saltness of Oceanic Currents.*—The equatorial current has in the bay of Benin a saltness of +3.8; crossing the equator between long. 25° and 35° W., this successively increases by evaporation to +17.3 and +20.8. On the same longitude, at lat. 15° S. the saltness is +31.5, lat. 12–14° N. +21.9 and 19.4; thus the current is less salt than the ocean near it—indicating the freshening influence of the great rivers of Guinea. Near St. Thomas, West Indies, the saltness is only +17—the enormous amount of fresh water from the Amazon and Orinoco reaching thus far—since a few degrees north of the current the saltness of the ocean is again +27. At the Bermuda Islands the saltness is +18.8—the evaporation in the Gulf has been counterbalanced by the waters of the Mississippi. Northward the Gulf stream increases to 21.0, 22.8, and 23.6; but at lat. 43° 26′, long. 44° 19′ W. where the St. Lawrence empties, the saltness abruptly sinks to +1.5 (a diminution of 2½ thousandths!). From this minimum it slowly rises to +18.9 and at last diminishes again in the higher latitudes. *These regular oscillations in the saltness of the great Atlantic current show the fresh water supply obtained from the great African and American rivers, and the effects of evaporation—and make it very probable that these rivers contribute to give the current its particular direction.* Forchhammer represents these numbers by a proportional *breadth* of the current (dotted for negative values)—thus showing at a glance this most important law.

The mean saltness of the polar current of Baffin's Bay is +8.2, but increasing towards north,

Latitudes,	58° 53′	64°	69°
Saltness,	+15.8	+10.3	+4

showing how the water of the Arctic sea is freshened by the northern rivers, Greenland glaciers, and the Hudson's Bay rivers.

* The maximum of saltness, +29, or 37.9 thousandths is in the north tropical part of the Atlantic, opposite the dry coasts of Sahara, whence hot, dry winds, but no fresh water may be obtained, lat. 24° 13′ N., long. 23° 11′ W.

The southern polar or *Humboldt's* Current (Region XV) gave +0s; it conducts waters from the Antarctic ocean, where −54 (Reg. XVI) has been observed.

(3.) *Counter-currents.*—The Sound, between Zealand and Sweden, exhibits the best investigated example of counter-currents: the surface-current being commonly south *from* the Baltic, the bottom-current always north, *into* the Baltic. According to observations made from April to Sept. 1846, the direction and saltness of these currents were in thousandths:

		To the Baltic.	From the Baltic.	No Current.
Surface,	days,	24	86	24
	saltness,	15994	13342	11801
Bottom,		19002		

and mean saltness of Reg. VII, the Baltic, 4807, of VI, Cattegat and Sound 15126 and North Sea (Reg. V) 32806 thousandths.

Thus the bottom current contains constantly by far the greatest amount of salt, even in winter, when its temperature is 2–3° F. higher (waters of the Atlantic) than the surface current, partaking of the winter temperature of the Baltic sea.

The saltness of about 20 points of the ocean has been determined for different depths. A difference of about one thousandth corresponds to the greatest depth observed, lat. 12° 36′, N. long. 25° 35′ W., depth 11,100 feet. The saltest water of the surface here evidently is the hottest.

In Davis Strait and Baffins Bay, no considerable difference of saltness for different depths is observed; but in the adjacent Atlantic the lower water is less salt than the warmer above it; and this same cold and less salt bottom current may be traced along the Atlantic, except where great quantities of fresh water are introduced by European and American rivers: making the lower strata the saltest.

In the Indian and Pacific the lowest water everywhere seems to be the saltest (only 4 observations).

(4.) *Composition of the salts.*—Twenty-five different elements have been observed in the salt of the ocean or in plants and animals of the sea: *O*, *H*, *Cl*, *Br*, I, Fl, *S*, P, *C*, N, Si, Fe, Mn, *Mg*, *Ca*, Sr, Ba, *Na*, *Ka*: Ag, Cu, Pb, Zn, Co, Ni; but only those printed in *Capitals* are predominant. Of these, chlorine, sulphuric acid, lime and magnesia may be determined with great exactitude. Comparing all analyses of *ocean water* (including the North Sea) it is found that the relative proportion of the components is nearly constant, being:

Chlorine 100, sulphuric acid 1191, lime 295, magnesia 1108. Total 1811 (for each 100 of chlorine).

The total is the most constant; yet there are small but constant differences for the different regions of the ocean—differences enlarging with the proximity of land, greatest in gulfs and bays, as may be seen from the following interesting comparison of the composition of the salt from Cronstadt (near St. Petersburgh) through the Baltic to the ocean.

To each 100 of chlorine corresponds:

	Lime.	Sulph. ac.	Total.
Cronstadt Harbor,	748	1497	2076
Gulf of Finland, midst,	581	1331	1836

	Lime.	Sulph. ac.	Total.
Gulf of Finland mouth,	378	1233	....
Sound (at Copenhagen),	338	1287	1814
Cattegat, at Anholt Isld.,	310	1209	
North Sea, 50 miles W. of Jutland,	319	1209	1816
Ocean, mean,	295	1191	1811

Thus, the animals extract a great part of the solid matter washed down to the sea by the rain, before it reaches the great ocean. G. H.

2. *Density of Ice.*—Dufour has determined the density of ice by two methods. 1st, by employing a mixture of alcohol and water in which the ice could just float, and then determining by the usual methods the density of this liquid. Every possible care was taken to eliminate the various sources of error which in the best conditions Dufour considered to be equal to 0·002. The ice used was carefully deprived of air by long boiling of the distilled water from which it was frozen. Twenty-two experiments by this method gave a mean density of 0·9175, with a mean error of $\pm$0·0007, the greatest and least errors being +0·002 and −0·0013. C. Brunner had previously, by another method, fixed the density of ice at 0·9180. Since the publication of these results (*Comptes Rendus*, L, 1039) Dufour has continued his researches by using a mixture of chloroform and rock oil which does not dissolve any portion of the ice, the temperature being kept from $-\frac{1}{2}°$ to − 8° C. The results reduced to 0°, with all needful precautions, gave for the mean of sixteen trials 0·9178, the greatest and least differences being +0·0015 and −0·0012, the mean difference being $\pm$0·0005. This result differs only 0·0003 from his former determination and but 0·0002 from that of C. Brunner. The expansion of a volume of water in the moment of freezing is therefore $\frac{9}{100}$, or $\frac{1}{11}$ of the volume of the water at 0° C. The former determinations of this constant are chiefly, Placidus Heinrich, (1807), 0·905; Thomson, 0·940; Berzelius, 0·916; Dumas, 0·950; Osann, 0·927; Plucker and Geissler, 0·920; C. Brunner, 0·918; and Kopp, (1855,) 0·909.—(*Comptes Rendus*, May 19, 1862.)

Chemistry.—

3. *Thallium: a new metal.*—The discovery by Crookes of a new element called *thallium*, was noticed in vol. xxxii, p. 411. Subsequently to his original announcement of this discovery (May, 1861) Mr. Crookes distinguished the true metallic character of this substance, which at first was referred by him to the sulphur group. More recently M. Lamy, a French chemist, without a knowledge of Mr. C.'s prior researches,* made the discovery of its existence (also by the spectroscope) while examining the selenium prepared by Mr. F. Kuhlmann from the deposits in the chambers in which sulphuric acid was made by the combustion of pyrites. From this residuum M. Lamy has succeeded in isolating the new metal which he thus describes:

Properties of Thallium.—Thallium has all the characters of a true metal, and, in most of its physical properties, greatly resembles lead. Not

* Mr. Crookes has communicated his researches in a memoir to the Royal Society of London, June 19, 1862, a transcript of which will soon appear in the Chemical News. We have already called attention to the preoccupation of the name *thallium* by Dr. Owen (this Journal [2] xiii, 420, 1852).—Eds.

quite so white as silver, it possesses a brilliant metallic lustre when freshly cut. It appears yellowish when rubbed against a hard body; but this tint is doubtless due to oxydation, for the metal precipitated by a battery from an aqueous solution, or fused in a current of hydrogen, is white, with a bluish grey tinge, which resembles aluminium.

Thallium is very soft, and very malleable; it can be easily scratched by the nail, and cut with a knife. It marks paper, leaving a yellowish streak. Its density (11·9) is a little higher than that of lead. It fuses at 290° C., and volatilizes at a red heat. Lastly, thallium has a great tendency to crystallize, for the ingots obtained by fusion crackle like tin when they are bent. But the physical property, *par excellence*, of thallium,—that which, according to the beautiful researches of MM. Kirchhoff and Bunsen, characterizes the metallic element,—that which led to its discovery,—is the property which it possesses of communicating to the pale gas-flame a green color of great richness, and to the spectrum of this flame a single green ray as distinct and as sharply defined as the yellow ray of sodium, or the red ray of lithium. On the micrometric scale of my spectroscope this ray occupies the division 120·5, that of sodium being at 100°. The slightest portion of thallium, or of one of its salts, gives the green line with such brilliancy that it seems white. The fifty-millionth part of a gramme can, according to my calculations, be recognized in a compound.

Thallium tarnishes rapidly in the air, becoming covered with a thin pellicle of oxyd, which preserves the rest of the metal from alteration. This oxyd is soluble, is decidedly alkaline, and has a taste and smell similar to potash. By this characteristic, as well as by its optical properties, thallium approaches the alkaline metals.

Thallium is attacked by chlorine, slowly at the ordinary temperature, rapidly at a temperature above 200° C. The metal then melts, becomes incandescent under the action of the gas, and gives rise to a yellowish liquid, which solidifies on cooling to a mass of a little paler color.

Iodine, bromine, sulphur, and phosphorus can also combine with thallium, forming iodids, bromids, sulphids, and phosphids.

Recently-prepared thallium preserves its metallic lustre in water. It does not appear to decompose this liquid at the temperature of ebullition, but, by the aid of an acid, it separates its elements, disengaging hydrogen.

Sulphuric and nitric acids are those which attack thallium easiest, especially by the aid of heat. Hydrochloric acid even boiling dissolves it with difficulty. Under these circumstances, there form white soluble salts, sulphate, and nitrate, crystallizing readily, and a slightly soluble chlorid, but capable also of crystallizing.

Natural State and Extraction.—Thallium cannot be considered as very rare in nature. It exists, indeed, in many kinds of pyrites, which are used at the present time in large quantities, principally for the manufacture of sulphuric acid. I may especially mention Belgian pyrites from Theux, Namur, and Philippeville. I have also found it in mineralogical specimens from Nantes and Bolivia, in S. America. * * * *

As to the metal itself, it may be reduced from one of its saline combinations either by the decomposing action of an electric current, or by precipitation with zinc, or by reduction with charcoal at a high tempera-

ture. The chlorine may also be separated from its chlorids by potassium or sodium, under the influence of heat; in this latter case the reaction is very energetic.

The small ingot, weighing fourteen grammes, which I had the honor of exhibiting to the Academy, was entirely isolated by a battery of a few Bunsen elements, first from the chlorids originally obtained, and then from the crystallized sulphate formed directly by the solution of this thallium in pure sulphuric acid. * *

In a subsequent communication I will endeavor to fill up some of the gaps at present wanting in its history.—*Chemical News*, July 19, 1862.

TECHNICAL CHEMISTRY.—

4. *Regenerative Gas Furnace.*—Mr. SIEMENS of London has contrived what he calls a regenerative gas furnace adapted to glass houses, iron puddling, and all kinds of furnaces, where long continued high heats are required. We copy Prof. Faraday's notice of this invention as communicated to the Royal Institution of Great Britain, June 20, 1862.

"The subject of the evening was gas glass-furnaces; and having arisen almost extemporaneously, it resolved itself chiefly into an account of the manner in which Mr. Siemens has largely and practically applied gas, combined with the use of his heat-regenerator, to the ignition of all kinds of great furnaces. Gas has been used to supply heat, even upon a very large scale, in some of the iron-blast-furnaces; and heat which has done work once has been carried back in part to the place from whence it came to repeat its service; but Mr. Siemens has combined these two points, and successfully applied them in a great variety of cases—as the potter's kiln, the enameller's furnace, the zinc-distilling furnace, the tube-welding furnace, the metal-melting furnace, the iron-puddling furnace, and the glass-furnace either for covered or open pots—so as to obtain the highest heat required over any extent of space, with great facility of management, and with great economy (one-half) of fuel. The glass-furnace described had an area of 28 feet long and 14 feet wide, and contained eight open pots, each holding near two tons of material.

The gaseous fuel is obtained by the mutual action, at a moderate red heat, of coal, air, and water. A brick chamber, perhaps 6 feet by 12, and about 10 feet high, has one of its end-walls converted into a fire-grate; *i. e.* about halfway down it is a solid plate, and for the rest of the distance consists of strong horizontal plate-bars where air enters, the whole being at an inclination such as that which the side of a heap of coals would naturally take. Coals are poured, through openings above, upon this combination of wall and grate, and being fired at the under surface, they burn at the place where the air enters; but as the layer of coal is from 2 to 3 feet thick, various operations go on in those parts of the fuel which cannot burn for want of air. Thus the upper and cooler part of the coal produces a larger body of hydrocarbons; the cinders or coke which are not volatilized approach, in descending, towards the grate; that part which is nearest the grate burns with the entering air into carbonic acid, and the heat evolved ignites the mass above it; the carbonic acid, passing slowly through the ignited carbon, becomes converted into carbonic oxyd, and mingles in the upper part of the chamber (or gas-producer) with the former hydrocarbons. The water, which is

purposely introduced at the bottom of the arrangement, is first vaporized by the heat, and then decomposed by the ignited fuel and rearranged as hydrogen (qu. also carburetted hydrogen, CH_2?) and carbonic oxyd; and only the ashes of the coal are removed as solid matter from the chamber at the bottom of the fire-bars.

These mixed gases form the gaseous fuel. The nitrogen which entered with the air at the grate is mingled with them, constituting about a third of the whole volume. The gas rises up a large vertical tube for 12 or 15 feet, after which it proceeds horizontally for any required distance, and then descends to the heat-regenerator, through which it passes before it enters the furnaces. A regenerator is a chamber packed with fire-bricks, separated so as to allow of the free passage of air or gas between them. There are four placed under a furnace. The gas ascends through one of these chambers, whilst air ascends through the neighboring chamber, and both are conducted through passage outlets at one end of the furnace, where mingling they burn, producing the heat due to their chemical action. Passing onwards to the other end of the furnace, they (*i. e.* the combined gases) find precisely similar outlets down which they pass; and traversing the two remaining regenerators from above downwards, heat them intensely, especially the upper part, and so travel on in their cooled state to the shaft or chimney. Now the passages between the four regenerators and the gas and air are supplied with valves and deflecting-plates, some of which are like four-way cocks in their action; so that by the use of a lever these regenerators and air-ways, which were carrying off the expanded fuel, can in a moment be used for conducting air and gas into the furnace; and those which just before had served to carry air and gas into the furnace, now take the burnt fuel away to the stack. It is to be observed that the intensely-heated flame which leaves the furnace for the stack always proceeds downwards through the regenerators; so that the upper part of them is most intensely ignited, keeping back, as it does, the intense heat; and so effectual are they in this action, that the gas which enters the stack to be cast into the air is not usually above 300° F. of heat. On the other hand, the entering gas and air always pass upwards through the regenerator; so that they attain a temperature equal to white heat before they meet in the furnace, and there add to the carried heat that due to their mutual chemical action. It is considered that, when the furnace is in full order, the heat carried forward to be evolved by the chemical action of combustion is about 4000°, whilst that carried back by the regenerators is about 3000°, making an intensity of power which, unless moderated on purpose, would fuse furnace and all exposed to its action.

Thus the regenerators are alternately heated and cooled by the outgoing and entering gas and air; and the time for the alternation is from half an hour to an hour, as observation may indicate. The motive power on the gas is of two kinds—a slight excess of pressure within is kept up from the gas-producer to the bottom of the regenerator to prevent air entering and mingling with the fuel before it is burnt; but from the furnace, downwards through the regenerators, the advance of the heated medium is governed mainly by the draught in the tall stack, or chimney.

Great facility is afforded in the management of these furnaces. If, whilst glass is in the course of manufacture, an intense heat is required,

an abundant supply of gas and air is given; when the glass is made, and the condition has to be reduced to working-temperature, the quantity of fuel and air is reduced. If the combustion in the furnace is required to be gradual from end to end, the inlets of air and gas are placed more or less apart the one from the other. The gas is lighter than the air; and if a rapid evolution of heat is required, as in a short puddling-furnace, the mouth of the gas inlet is placed below that of the air inlet; if the reverse is required, as in the long tube-welding furnace, the contrary arrangement is used. Sometimes, as in the enameller's furnace, which is a long muffle, it is requisite that the heat be greater at the door end of the muffle and furnace, because the goods, being put in and taken out at the same end, those which enter last and are withdrawn first, remain of course, for a shorter time in the heat at that end; and though the fuel and air enters first at one end and then at the other alternately, still the necessary difference of temperature is preserved by the adjustment of the apertures at those ends.

Not merely can the supply of gas and air to the furnace be governed by valves in the passages, but the very manufacture of the gas fuel itself can be diminished, or even stopped, by cutting off the supply of air to the grate of the gas-producer; and this is important, inasmuch as there is no gasometer to receive and preserve the aëriform fuel, for it proceeds at once to the furnaces.

Some of the furnaces have their contents open to the fuel and combustion, as in the puddling and metal-melting arrangements; others are enclosed, as in the muffle furnaces and the flint-glass-furnaces. Because of the great cleanliness of the fuel, some of the glass-furnaces, which before had closed pots, now have them open, with great advantage to the working, and no detriment to the color.

The economy in the fuel is esteemed practically as one-half, even when the same kind of coal is used either directly for the furnace or for the gas-producer; but as in the latter case the most worthless kind can be employed, such as slack, &c., which can be converted into a clean gaseous fuel at a distance from the place of the furnace, so many advantages seem to present themselves in this part of the arrangement.

It will be seen that the system depends, in a great measure, upon the intermediate production of carbonic oxyd from coal, instead of the direct production of carbonic acid. Now carbonic oxyd is poisonous, and, indeed, both these gases are very deleterious. Carbonic acid must at last go into the atmosphere; but the carbonic oxyd ceases to exist at the furnace, its time is short, and whilst existing it is confined on its way from the gas-producer to the furnace, where it becomes carbonic acid. No signs of harm from it have occurred, although its application has been made in thirty furnaces or more.

The following are some numbers that were used to convey general impressions to the audience. Carbon, burnt perfectly into carbonic acid in a gas-producer, would evolve about 4000° of heat, but if burnt into carbonic oxyd it would evolve only 1200°. The carbonic oxyd, in its fuel form, carries on with it the 2800° in chemical force, which it evolves when burning in the real furnace with a sufficient supply of air. The remaining 1200° are employed in the gas-producer in distilling hydrocar-

bons, decomposing water, &c. The whole mixed gaseous fuel can evolve about 4000° in the furnace, to which the regenerator can return about 3000° more."—*Phil. Mag.*, Aug., 1862.

[The readers of this Journal will remember my description of the furnaces of Moses Thompson for the combustion of wet fuel, (this Journal, [2], xxx, 243). The chemical reactions and many essential points of construction in the two cases are quite identical—the slow combustion of the wet fuel in an anterior furnace very imperfectly supplied with air—the reaction of the vapor of water with the carbonaceous gases in the mixing chamber—the intense heat therein produced by these reactions—the low temperature of the smoke stack are all features of similarity, while the alternate use of the combustion chambers supplied a species of *regenerator*, in fact, if not in name. If Mr. Siemens has not seen Mr. Thompson's plans and specifications, or my description above referred to, he will find in them another proof of the old adage that "there is nothing wholly new under the sun."—B. S., JR.]

II. GEOLOGY.

1. *Dyas, oder die Zechstein Formation und das Rothliegende;* by Dr. HANNS BRUNO GEINITZ, Leipzig. 13 pp. 4to, and 23 plates. Leipzig, 1861. (Second notice).—In the former mention of this work (vol. xxxiii, p. 425) some of the objections were stated to the substitution of the term *Dyas* for *Permian* in geology, and a further notice of the contents of the volume was promised in a future number. We have not yet received the promised review, but the great value of the work and its special interest to American geological science on account of its bearing on the question of the existence of American Permian rocks, leads us to give without delay an abstract of its contents kindly prepared by Mr. A. Schott. The citations are such as bear directly on the question as to whether the Permian is Palæozoic or Mesozoic in its relations—the former being the view now generally held by geologists and sustained by Dr. Geinitz. The work is illustrated by many plates admirable in lithography as well as in accuracy of drawing.

Since 1848 the zoological species of the Permian or "Dyas" have been increased to thrice the original number. This recent work by Dr. Geinitz contains descriptions of 216, some of which are new. All the species hitherto described and known to the author are included.

After extensive study, and a close scrutiny of the fossils, Dr. Geinitz states that the principal leading forms of the formation (the Zechstein) belong to types that are especially characteristic of the Palæozoic era, although some older types, as for instance Trilobites, had disappeared during the preceding Carboniferous period.

The tribe of Saurians, the Russian species excluded, are represented by 9 or 10 species, among which are Lacertians and Labyrinthodonts; the latter appear for the first time during the Carboniferous age and reach their highest development during the Trias.

Of Fishes, 43 species are described, among which *heterocercal* ganoids prevail, and no *homocercal* species occurs. The smooth-scaly species of *Palæoniscus* of the "Rothliegende" and *Acanthoides gracilis* here prove the relationship of the formation with the Carboniferous.

Out of 25 species of Crustacea, besides Entomostraca, which are well known to increase through the earlier formations, there are the more highly organized Tetradecapods and Decapods, the former of which seem to have taken the place of Trilobites. The Tetradecapod described and figured is the *Prosoponiscus problematicus* first described by Schlotheim. It has been recently shown by C. Spence Bate to be an Amphipod. One species is referred to the Brachyurans. It is the *Hemitrochiscus paradoxus* of Schauroth. Dr. Geinitz considers it as related to species of the Pinnotheres family.

Only three species of Annelids have yet been observed.

The species of Cephalopods in the Zechstein are three in number. They do not assist in determining the relations of the Permian period; but there are three species of Pteropods which again point to the Palæozoic era.

Among 25 species of Gasteropods and 50 of Conchifers there are both Palæozoic and Mesozoic forms; of the former *Straparollus* and *Murchisonia*, and of the latter *Schizodus* and *Pleurophorus* have not been observed beyond the Zechstein.

Of Brachiopods, of which 30 species are distinguished, all the leading forms characterizing the Zechstein offer the most indisputable proof of its Palæozoic relations. Some of the genera, as *Productus* and *Strophalosia*, by their immense numbers of individuals performed the same part in this period as Conchifers during the Mesozoic era. Besides these two genera, *Orthis* and *Camarophoria* belong exclusively to the Palæozoic, while *Terebratula* and *Spirifer* occur in later beds. But the very common *Terebratula elongata* of the Zechstein approaches a Devonian form. Moreover, the closest relationship exists between *Camarophoria Schlotheimi* of the Zechstein and *Camarophoria Crumena* of the Carboniferous; between *Spirifer Clannyanus* of the Zechstein and *Spirifer Urii* of the Carboniferous; between *Spirifer cristatus* of the Zechstein and *Spirifer octoplicatus* of the Carboniferous; and between *Lingula Credneri* of the Zechstein and a Lingula of the Coal-measures of Ryhope near Sunderland. These various equivalent forms so closely approach each other, that Davidson and Kirkby pronounced them identical.*

Among the Radiates, *Cyathocrinus ramosus* belongs to a genus only known as belonging to older formations; *Eocidaris Keyserlingi* stands nearest to the Palæozoic genus *Archæocidaris;* a third species, a six-rayed Asterias, is not yet sufficiently known to permit of any conclusion.

Thirteen corals, all related to *Fenestella*, a genus prevalent in the Zechstein, with other species of *Stenopora*, all point to the Palæozoic era. There are 12 species of Foraminifera and 7 of Amorphozoa in the beds. Our knowledge of these tribes in the Zechstein is yet very limited.

We come now to the pages on the Plants of the Permian. The general aspect of the Flora is beyond question Carboniferous and not

* See Kirkby on the occurrence of Lingula Credneri in the Coal-measures of Durham. Quar. Journ. Geol. Soc. London, 1860, xvi, p. 412 and f. Dr. Geinitz dissents from some of the views here proposed.

Mesozoic. Some species of the Coal-measures reach into the "Rothliegende," as for instance *Cyatheites arborescens*, *Walchia piniformis* and some *Nœggerrathiæ;* while other leading plants of the Rothliegende, as *Annularia carinata, Calamites infractus* and others have their nearest relations in the Carboniferous *Annularia longifolia, Calamites approximatus*, etc. The Flora of the Rothliegende very closely approaches that of the Coal-measures, although along with the characteristic Palæozoic genera, there are some others that have their largest expansion in the Mesozoic. The Dyas or Permian is hence pronounced to be Palæozoic as well on the ground of its organic remains as its stratigraphical relations.

3. *Preliminary notice of some of the species of Crinoidea known in the Upper Helderberg and Hamilton Groups of New York* (published July, 1862.); by JAMES HALL—from the 15th Report on the Cabinet of Natural History of the State of N. Y. (Senate, No. 116) pp. 115 to 152. These advance sheets from the 15th Regents' Report embrace descriptions of species of the following genera. The new genera are printed in capitals.

EDRIOCRINUS, *Hall*, Cheirocrinus, (*Hall*), ANCYROCRINUS (*Hall*), Platycrinus, (*Miller*), Poteriocrinus, (*Miller*), Cyathocrinus, Forbesiocrinus, (*De Koninck*), Rhodocrinus, (*Miller*) [subgenus] Acanthocrinus? (Rœmer), Trematocrinus, (*Hall*), Actinocrinus, (*Miller*), A. = Megistocrinus, (*Owen*), Cacabocrinus, (*Troost*, Catalogue) Dolatocrinus? (*Lyon*), Myrtillocrinus? (*Sandberger*), Haplocrinus, (*Steinberger*), Nucleocrinus, (*Conrad*, as emended, Pentremites, Olivanites, (*Troost*), Elæacrinus, (*Rœmer*), Pentremites, (*Say*)), Eleutherocrinus, (*Shumard*), Codaster, (*M'Coy*).

4. *Dana's Geology.*—This long expected volume will appear in a few weeks. It will be published by Theo. Bliss & Co., Philadelphia, in an 8vo volume of about 750 pages, beautifully illustrated by about 1000 wood cuts, drawn chiefly from American examples or the author's own experience. It will be looked for we know with pleasure, not more for its own sake, than as an evidence of the returning health of its author.

S.

5. *The Student's Manual of Geology;* by J. BEETE JUKES, M.A., F.R.S.E., Local director of the Geological Survey of Ireland, &c. A new edition, partially recast and supplied with lists and figures of characteristic fossils. Edinburgh: Adam & Chas. Black. 1862. 12mo, pp. 760.

The new edition of this standard work has just reached us. It is specially rich in facts drawn from Great Britain, but will be read by geologists generally with interest.

III. BOTANY AND ZOOLOGY.

1. *Antherology.*—"*Note on the Structure of the Anther*," is the title of a short paper read by Prof. Oliver of King's College, London, before the Linnæan Society last November, and printed in the 23d volume of its Transactions. No doubt much remains to be done regarding the structure and homology of the anther. The current hypothesis, as to how the several parts of a stamen are homologous with a leaf, is indeed rather that which "may reasonably be supposed" to be true, or which

may serve to give a clear conception of the probable relation, than that which can be said to be conclusively made out. The present paper, upon the strength of an interesting monstrosity in the flowers of a *Geranium*, controverts the current view in some respects, mainly in that point which identifies the line of the dehiscence of the anther cell with the margin of the blade of the leaf. As to this, it is obvious enough that the lines of dehiscence in the outermost and less complete anthers of *Nymphæa* are really not continuous with the margins of the petal-like filament, and also that the cells appear to belong to the upper stratum of the stamineal leaf. Yet we are not clear that the current hypothesis, liberally interpreted, need be discarded, although it needs modification. That the anther answers to the blade of a leaf, and the pollen to parenchyma, specially developed, Prof. Oliver equally holds; but his conception of the homology of the bilocellate anther-cells is not explicit, at least, we do not well apprehend it. So good an observer as he is will hardly be content until he shall be able to offer a clearer as well as completer exposition.

Upon Mohl's authority, the ordinary received view is credited to Cassini. But Brown's Rafflesia-paper is a year earlier than Cassini's article referred to; and we suppose that Brown would have claimed that his paragraph on the type of the anther, on p. 211, with the appended foot-note, expresses or implies nearly the whole. And Rœper, who soon after developed the hypothesis nearly as now received, refers to Brown, but not to Cassini. It is true that Brown, in his notion that pollen was produced, like ovula, "on the margins of the modified leaf," was quite astray. But it is curious that Prof. Oliver, who quotes this remark, seems not to have noticed that it, in connection with the context, by implication must assign to Brown the paternity of the current hypothesis, at least as respects the point which is here controverted. And this hypothesis accords so well with nine anthers out of ten, and those the most normal, that, with Mohl, we are not yet inclined to abandon it. "That the septa of 'untransformed tissue' may be regarded morphologically as resulting, in part from the inflected epidermis of the adjacent anther-cells," would be readily conformable with Brown's view, as we judge from his language; and the fact that the septum frequently shows signs of being bilamellar, might also be adduced. But, on the other hand, its organic connection with the connective, or with the dorsal part of the cell, and not with the line of dehiscence, is too obvious to be overlooked.

Holding, still more strictly than does Prof. Oliver, the notion that the anther *is* the body or lamina of the stamineal leaf, we must agree with him in his estimate of the peculiar theory of Mr. Bentham, broached several years ago, and recently explained and defended, (in Jour. Linn. Soc. 6, p. 118, 122), viz., that anthers are homologous with petiolar glands, the lamina in stamens being either wholly absent, or represented by a petaloid appendage of the connective, of which we suppose that of most *Compositæ* and in *Asclepias* would be good examples. Viewed morphologically or physiologically, this seems to us equally a retrograde step. But if we did receive this hypothesis, we should be led thereby to believe (which now we do not) that a petal with a stamen before it might sometimes be homologous to a single leaf.

In his important "*Notes on Malvaceæ and Sterculiaceæ*—the article

above referred to—among other matters of high consideration, Mr. Bentham works out his hypothesis of glandular stamens with some detail, in explanation of the androecium of certain *Sterculiaceæ*. We are not prepared to discuss the points here involved, not only because this would require time and space which we cannot now afford, but also more knowledge than we can now pretend to. But we would remark:—

(1.) That we are well satisfied in finding that Mr. Bentham fully accepts the view that a single leaf of the *andrœcium* may be represented by a phalanx of stamens (this, indeed, he had previously favored), or by a cluster of stamens and a scale or petaloid body, such for instance as we have in an American *Tilia;* also "that a *dédoublement* of the petal may produce the inner petaloid scale of some *Sapindaceæ*, *Violaceæ*, *Bixaceæ*, &c., or the fimbriate scales in the tube of *Cuscuta* and other gamopetalous flowers." That is about as far as we incline to go in this direction. But, as Mr. Bentham homologizes these scales or appendages with petiolar glands on the one hand and with anthers on the other, he ought not greatly to object when some convert to his theory imagines such potential anthers to become actual ones.

(2.) But Mr. Bentham's ingenious hypothesis to account for the antepesition of the outermost stamens to the petals in *Sterculiaceæ*, &c., as deduced from *Glossostemon*, apparently would work just as well on the supposition that the anthers answer to the leaflets of a palmately compound leaf, the middle one sterile. And

(3.) *Sidalcea*, that most instructive Malvaceous genus, and a pentandrous *Parvonia* on the one hand, and the American section of *Tilia* on the other, taken together, offer to our view most serious if not conclusive objections to the conjecture that, in the family in question, the real or the primary verticil of stamens does in fact alternate with the petals, and is indicated by the teeth or stamniodia, these representing the axes or apices of so many leaves which, revolute in æstivation, are laterally antheriferous. Nor do we see how this view applies to *Melochia* and its allies, where only a single stamen stands before each petal, unless these stamens are conceived to be double, as is supposed of *Fremontia*.

(4.) Apropos to the latter, and much inclined to accept Mr. Bentham's views in regard to the androecium of *Bombaceæ*, we remark that the position of the stamens when reduced to a single verticil, as in *Fremontia*, *Cheirostemon*, and *Eriodendron*, is before the sepals, instead of being before the petals as may be deduced to be the case in the true *Malvaceæ* no less than in *Sterculiaceæ* and in *Tilia*. Whatever hypothesis be adopted in explanation, the position of the stamens relative to adjacent parts of the flower is important. On this and other accounts, in the annexation of the *Bombaceæ* to *Malvaceæ*, we could not hesitate to accord to the group the rank of a suborder. A. G.

2. *Wood-cells of Hamamelideæ imitate Coniferous markings.*—A paper "*On Sycopsis*," a new Hamamelideous genus, published by Professor Oliver, in the 23d volume of the Linnæan Transactions, brings to view a fact discovered by the late Mr. Griffith, in *Bucklandia*, and announces for all the other genera of this order, that the wood-cells exhibit markings "in all respects quite similar to those of the so-called 'glandular markings' of coniferous wood." As Prof. Oliver hints at an affinity to or pos-

sible remote derivation from *Coniferæ* being indicated thereby, it may be interesting to note that Mr. Brown, in the 19th volume of the Linnæan Transactions (p. 231) draws from analogous facts an opposite conclusion, viz.: "That conformity in vascular structure, even when accompanied by peculiarity of tissue, does not always indicate, much less determine, botanical affinity." Which is considerably safer than the genealogical view hinted at by Prof. Oliver. As the wood of *Hamamelideæ* has the usual proportion of vessels, &c., Prof. Oliver intimates, as well he may, that it offers "a higher measure of specialization" than that of Coniferæ, even although the latter has been "designated by a distinguished naturalist as the highest specialized tissue known." Interesting remarks are given upon the geographical distribution of this order. A. G.

3. *Journal of the Proceedings of the Linnæan Society, Botany.* Nos. 22, 23.—Having already drawn upon articles contained in these numbers, we need only enumerate the contents, viz.:

Col. Munro's *Identification of the Grasses of Linnæus's Herbarium* is concluded.

Mr. Bentham contributes *Notes on Caryophylleæ, Portulaceæ and some allied Orders;* also *Notes on Malvaceæ and Sterculiaceæ.* The results of these papers find their place in the new Genera Plantarum of Bentham and Hooker, the first part of which is nearly all printed.

On the Two Forms or Dimorphic Condition in the Species of Primula, and on their remarkable Sexual Relations; by CHARLES DARWIN.—The two forms are identical with those of *Houstonia*, and the like, long ago recognized by our botanists; and those of *Primula* have perhaps been longer known in Europe. That this was a transition towards a separation of the sexes was an early and obvious suggestion; but the fact that both forms seeded freely seemed to negative that supposition. It remained for Mr. Darwin to show, and he has admirably shown, that the object of the arrangement is to secure cross-fertilization between the individuals of the same hermaphrodite species,—an object effectually reached in nature in many different ways, most commonly through the agency of insects; and here is one of the adaptations to this end. The details we may perhaps explain upon some convenient occasion.

West African Tropical Orchids, by Dr. Lindley.

Notes on *Contoubea volubilis, Mart. and some other Gentianæ of Tropical America*, by Dr. Grisebach. The plant in question is a homely, small-flowered, voluble plant of C. Wright's Cuban collection, No. 1372, to which, the name now being vacant, Dr. Grisebach has transferred that of *Gœppertia*. In annotations upon plants of the order, the author remarks of *Erythræa* and four other related genera, that they are mere artificial distinctions. He might have added *Gyrandra* to the list. Another very interesting and striking plant of Wright's collection, No. 1346, is the type of a new genus, namely, *Zonanthus Cubensis*.

On Inocarpus, by Mr. Bentham, the President of the Society. Curiously enough, Forster's genus *Inocarpus*,—a well-known tree of the South Sea Islands, the seeds of which, boiled or roasted, are eaten like chestnuts,—proves in Mr. Bentham's hands to a Cæsalpineous Leguminosa, with a gamopetalous corolla, allied to the South American *Etaballia* and to the little known *Bocoa* of Aublet. A. G.

Address of George Bentham, Esq., President, read at the Anniversary Meeting of the Linnæan Society, May 24, 1862.—A Botanist succeeding to the chair ably filled for several years by a distinguished Zoologist, very naturally and properly takes up his own department for his illustrations when, upon such an occasion, he passes in review the principal works and investigations in natural history recently produced, and when he indicates some of the most promising fields now open to the young naturalist, especially to those who can devote but a portion of their time to science. The survey, as would be expected, is candid and fair, the advice eminently practical, and the particular example which he commends—"the remarkable success which has attended the long-continued, persevering, and well-combined observations of Mr. Darwin," which in detecting "the wonderful contrivances for the cross-fertilization of Orchids," "has revealed to us so much of surprising novelty in the economy of nature"—contrivances "which had hitherto been unsuspected, even by those botanists who had specially devoted themselves to that family—is wonderfully stimulating. "And this," continues the President, "is but a sample of that extraordinary variety of facts collected by him, and brought to bear upon his theories, which must be patent to every impartial reader of his works; whilst all who have had an opportunity of watching his *modus operandi* are well aware that he never brings forward an observation without taking every precaution to ensure its accuracy, thoroughly sifting every circumstance that appears to militate against it. It is indeed to be hoped that, without waiting for the completion of the great work that is to embody the whole series of his *pièces justificatives*, Mr. Darwin will continue to illustrate separate portions of his subject, each one of which is sufficient to give a lasting name to its author. In the meantime, let every lover of nature, who from his residence in the country may have leisure and opportunities of observing, follow in the track thus opened out." . . . Let us adopt for the insects and plants of our islands the nomenclature and classification the most convenient for study, and devote our attention to their economy and development, to the complicated structures disclosed by the microscope, and to those innumerable influences which we term accidental, but which appear all to form part of one general plan for the balance of power in the natural world."

These remarks, from one who is supposed by no means to favor Mr. Darwin's theory of derivation of species, seem to us better considered and more consonant with the scientific spirit of the age, than some others which eminent naturalists have thought it their duty to make. A. G.

4. *Botany of Northeastern Asia.*—The Russian botanists are still active in researches and publications relating to the flora of that portion of the empire (including its newly-acquired territories) which approaches North America—botanically even more than geographically—and which we must regard with peculiar interest. The *Flora Ajanensis*, (1858), and the *Primitiæ Floræ Amurensis*, (1859), are now followed by Dr. Regel's *Tentamen Floræ Ussuriensis*, (1861, pp. 228, imp. 4to, with 12 plates; separately issued from the Memoirs of the Imperial Academy, St. Petersburgh), an account of the plants collected in the district of the Ussuri River, northeast of Corea; and still later by the first part of the Botany of Radde's Journeys in Southeastern Siberia, (*Reisen in den Süden von*

Ost-Sibirien, im Auftrage der Kaiserlichen Russischen Gesellschaft, ausgeführt in den Jahren, 1855–1859, *durch G. Radde*, Bot. Abth. Moscow, 1861, 8vo), by the same indefatigable author. Of the latter we have only the first part, of 211 pages, and five 4to plates. It is a more extensive work than the general title would denote, being a kind of supplement to the Flora Rossica, for all accessions from the wide regions east of the Altai, including Kamtschatka and even Sitcha. Its fullness may be estimated when we state that the 211 pages before us extend only from the *Ranunculaceæ* to the *Cruciferæ* inclusive; and also that, in the form of notes, Dr. Regel gives new and complete revisions (at least for the Russian Empire) of many of the larger or more difficult genera, or their more troublesome sections. *Pulsatilla*, *Adonis*, *Aconitum*, *Corydalis*, *Barbarea*, and a part of *Draba* are thus revised, on the author's own proper observations, and apparently upon excellent principles. Among other things which attract our attention, we note that he replaces the name *Ranunculus Purshii*, Hook., by the earlier *R. radicans*, C. A. Meyer; he should have gone back to the earlier name, (*R. Gmeleni*, DC.); that having a second apetalous *Isopyrum*, he takes up Rafinesque's genus *Enemion;* and that he suspects *Caulophyllum robustum* to be only a geographical variety of *C. thalictroides*. As to this, we had here reached the same conclusion, from such incomplete comparisons as we could make; but additional materials are wanted. To the works abovementioned we may add Dr. Regel's Revision of the Russian and outlying species of *Thalictrum*, a separate publication, pp. 50, 8vo, with three plates. The first plate represents *T. sparsiflorum*, which, Dr. Regel will perceive from the observations in this Journal, under No. 76 of Dr. Parry's collection, is truly a denizen of North America. These publications are all full of matters of immediate interest to us, and suggestive of numerous particular enquiries; and their continuation with the same acuteness and spirit, promises much for the advancement of our knowledge of the vegetation of the northern temperate zone, and of the geographical relations of the species. A. G.

5. *Cork.—De la Production Naturelle et Artificielle du Liége dans le Chêne-Liége*, par M. Casimir de Candolle. (Ext. from the Mém. Soc. Phys. et d'Hist. Nat., Genèv., vol. xvi, 1860), with 3 plates. This paper is interesting as the first botanical publication of the inheritor of this honored name in the third generation of botanists, and as an account of the formation and structure of cork in the Cork-oak, both in the natural state, and especially under the operation which has to be practiced in order to the production of cork of any commercial value. The operation consists in the removal from the trunk of the natural corky layer of the bark down to the subjacent cellular envelope or green layer; which is done in Algeria, (where young De Candolle's observations were made), during the summer or autumn. Shortly after this operation, a new corky stratum begins to form in the green layer, at a variable distance from its denuded surface. This grows by annual layers upon its internal face, just as the original and worthless corky layer did; but this is much finer and much more elastic, and is the commercial article. When this valuable cork has attained sufficient thickness, ordinarily after seven or eight years, it also is removed, with the same result as before, i. e., still another

new corky stratum is formed below; and so successive crops may be taken off the trunk every seventh or eighth year for a long while, or even indefinitely. A. G.

6. *Martius, Flora Brasiliensis*, fasc. xxix, and fasc. xxx; both issued in January, 1862. The first of these contains the remaining tribes, *Dalbergieæ* and *Sophoreæ*, of the Papilionaceous *Leguminosæ*, elaborated by Mr. Bentham, pp. 218–350, tab. 57–127, with Indexes and a title-page,—so that the *Papilionaceæ* of themselves compose a volume. The name of the author warrants the excellence of the elaboration. The plates profusely illustrate the *Dalbergieæ*, and were drawn at Munich. The 30th fasciculus, a comparatively small one, is devoted to the *Scrophularineæ*, elaborated by Prof. J. A. Schmidt, of Heidelberg, to the illustration of which 18 plates are devoted. So this great work makes very good progress. A. G.

7. *Grisebach's Flora of the British West Indian Islands;* Parts iv and v have appeared since our last notice. Although the third part closed with an index, and contained the title-page as of the first volume, we are pleased to find that these are only temporary, that the paging runs on into the new parts, so that the whole will compose only one volume. As part 5 finishes the *Monocotyledons*, and part 6 is already in press, we look for an early completion of this important work. Meanwhile C. Wright's collections in Cuba are invaluable contributions of materials for a Flora of Cuba. In the present volume, and in the forthcoming portion of his memoir upon Wright's Cuban collection, Prof. Grisebach has done much to clear up our knowledge of West Indian *Rubiaceæ*, and to improve or complete the characters of the tribes and subtribes. *Erigeron Bonariensis* of Linnæus we have taken to be something distinct from *Conyza albida*. It should be looked up from original sources. *Chionanthus*, no less than *Linociera*, has albuminous seeds, as long ago noted here. *Dianthera* of Gronovius and Linnæus is rightly taken up. Linnæan genera are not to be superseded by later names. A. G.

8. *On the genus Euphorbia in DeCandolle's Prodromus;* by G. Engelmann.

After an interval of five years a continuation of the Prodromus, constituting a part of the 15th volume, has just made its appearance, containing a monograph of the suborder *Euphorbieæ* by E. Boissier. The celebrated author has in this work described and arranged with admirable care, conscientiousness and lucidity the heretofore almost unapproachable mass of species of one of the most numerous genera of plants spread over the whole globe. He has, with great propriety retained this eminently natural genus as Linnæus constituted it, retaining as subdivisions some of the numerous genera into which former authors from Haworth to Klotzsch and Garcke have sought to divide it.

Mr. Bossier describes 693 species, which for the greatest part he had seen and carefully analyzed himself, and adds 30 others as incompletely known, thus constituting the most numerous genus known, after *Panicum*, of which Steudel enumerates 864 species, and larger than *Senecio* of which DeCandolle knew 601 species. These species are arranged into two great divisions, the *Appendiculatæ*, with *petaloid* appendages to the glands of the involucrum, and the *Exappendiculatæ*, without such appendages. The former, containing 253 species, are for the greater part found in America: the latter, with 440 species, principally inhabit the Old World. This division of the genus is probably the most natural that could be made, though the first five species of the division are called by M. Boissier himself *Gymnadenieæ*, thus referring them properly to

the second division, and though other closely allied forms, such as *E. corollata* and *E. Ipecacuanhæ*, had to be widely separated on account of the difference in this particular.

The *Appendiculatæ* are divided into 11 sections, the first and largest of which is *Anisophyllum* with 176 species, the best known representatives of which with us are *E. maculata* and *E. hypericifolia*, here called *E. Prestii*. We have in our flora 36 species of this section; one of these, *E. Prestii*, is spread over the whole of North America; 6 are found in the Mississippi valley or east of it; 3 common in the West Indies, extending into Florida (of these *E. hypericifolia*, L., proper, is not mentioned as a Florida plant by Mr. Boissier) 24 are peculiar to the western plains, Texas, New Mexico and Arizona, and 2 are exclusively Californian. Several of the 24 southwestern species extend farther south into Mexico, and 2 of them, *E. prostrata* and *E. serpens*, which latter extends up the Mississippi and its confluents, are wide spread species found through the warmer parts of the whole globe.

Mr. Boissier has recognized several forms as distinct species in which I have only been able to see so many varities of one polymorphous species. Thus the old *E. hypericifolia* comprises his small-flowered and fruited tropical *E. hypericifolia* proper, our larger-flowered, larger and darker-seeded *E. Prestii*, and several tropical and eastern forms, as the hairy-fruited *E. lasiocarpa*, the large seeded *E. Brasiliensis*, and others. *E. zygophylloides* was very properly separated from *E. petaloidea*, but *E. polyclada* I suspect is only a form of the latter. *E. micromera*, which I had taken for a form of *E. polycarpa*, seems well distinguished. I may add here that the western *E. serpyllifolia*, formerly united by me to several forms of the old world under the name of *E. inæquilatera* and *E. glyptosperma*, have lately been found by Mr. T. J. Hale in Wisconsin, as also *E. Geyeri* first discovered in Illinois, which last seems to preserve its distinction from *E. petaloidea*.

The second section, *Zygophyllidium*, comprises 4 species, of which 3 belong to the southwest and one to Mexico.

The 25 species of the 3d section, *Cyttarospermum*, are all inhabitants of the warmer parts of America, 13 being Mexican, and only one of our species, *E. bifurcata*, perhaps an intermediate link between this and the former section, is doubtfully referred here.

Sections 4 and 5 contain few, only American species, none of them belonging to our flora.

Section 6, *Petaloma*, consists of 3 species, two of which, *E. marginata* and *E. bicolor*, belong to the west and southwest, and the third is a closely allied Mexican form.

Sections 7 and 8 are small and almost entirely South American.

The 9th section, *Tithymalopsis*, on the contrary, is entirely North American, 7 species belonging to our flora and one to Mexico. *E. corollata*, including *E. paniculata*, is the wide-spread and well-known representative of this section. The heretofore imperfectly known Michauxian species, *E. pubentissima* and *E. mercurialina* have been restored by Mr. Boissier, after a careful examination of the original specimens in Richard's herbarium, now in the hands of Mr. Franqueville of Orleans. The former, however, may be a variety of *E. corollata*. Mr. Boissier has from the same source ascertained that *E. polygonifolia* Michx., is a form of *E. Curtisii*, though his other specimens, in the herbarium, of the Jardin des Plantes in Paris, is a form of *E. Ipecacuanhæ*.

Trichosterigma, the 10th section, comprises 5 species, all of them Western Mexican, two of which reach into our boundaries. The 2 species of the 11th section belong to South America.

The second great division, *Exappendiculatæ*, is divided into 16 sections, 2 of which only are represented in the North American Flora.

Sections 12–14 contains few species, none of them belonging to our flora.

Section 15, *Poinsettia*, with 11 species, is almost entirely North American, or

properly Mexican; 1 or 2 species extending farther south, and 6 reaching into our flora. The best known representative of this section, *E. heterophylla*, has been restored, recognizing *E. cyathophora* and *E. graminifolia* as varieties of the Linnean species. The New Mexican *E. cuphosperma*, which I had described as a form of *edentata*, is here described as a distinct species. *E. erianthα* ought to have been mentioned as also occurring in Arizona. It may be remarked that the name of Arizona does not occur in this or other botanical publications, as a district formerly of the Mexican State of Sonora; just as Louisiana even yet, after 50 years of separate existence, sometimes is used in botanical works for the Upper Missouri country.

Sections 16–25, with 115 species, almost all belong to the Old World; they include the Euphorbiæ with succulent stems, those with the forms of Cacti.

Section 26, *Tithymalus*, comprises the great mass of the Euphorbiæ of the Old World. Of the 302 species constituting it we furnish only 23, most of which belong to the southwest; 5 others have been sparingly introduced from Europe into the eastern States.

The sub-section *Ipecacuanhæ* is the only sub-section of *Tithymalus*, whose species, 19 in number, all belong to the New World: 4 of them are peculiar to the Southeast; one comes over from the West Indies to the southern extremity of Florida, and allied, as it appears, to the Chilian forms, is peculiar to Southeastern New Mexico.

Of the sub-section *Galarrhæi* (with obtuse glands), out of 108 species we have only 5 native species, distributed from the Alleghany Mountains to western Texas and California.

The largest sub-section, *Esulæ*, (with two-horned glands), comprising 139 species, counts in our flora 12 species, 2 of them in the middle and southern States, and all the rest belonging to Texas, New Mexico and California.

The 27th section is constituted by a single species, an Australian shrub.

We find the name of two of our published species *E. commutata* Englm. in Gray's Manual, and *E. Floridana*, Chapm. in his Southern Flora, replaced by *E. Ohiotica*, Steud. & Hochst. and *E. sphærosperma*, Shuttlew., names which have been published only on labels in distributed collections, while *E. Rügeiana* Shuttlew., has not been substituted for *E. Curtisii* though published in the same manner. [We must insist on the restoration of the earlier published names, given without knowing of the distributed ones on tickets.—Eds.]

The following table exhibits the geographical distribution of the 80 species of Euphorbia, credited by M. Boissier to the Flora of the United States. The immense extent of this Flora may be properly divided into five districts.

I. Flora of the Northern and Middle States, or the Flora of Gray's Manual, which however should naturally include the wooded part of Missouri, and exclude Northern Illinois and Wisconsin or the Northwestern Prairie region. I adopt, however, Prof. Gray's limits, adding Missouri.

II. Flora of the Southeastern and Southern States, east of the Mississippi, or the limits of Chapman's Flora.

III. Flora of the Western Prairie Region from the British Possessions to the Rio Grande.

IV. Flora of the Rocky Mountains, including the greater part of Washington and Oregon, the whole of Utah, Colorado, New Mexico and Arizona.

V. Flora of the Pacific slope of the continent.

Some species extend through most of these regions, while others are common to several of them, and others again are limited to a single one; some extend into the extreme limits of our Flora from the southern countries adjacent. The species, therefore, may be divided according to their geographical extension into the following 12 classes:

1. Species common to the greater part of our territory. I class here *Euphorbia Preslii*, *serpens*, *serpyllifolia*, *maculata*, *corollata*, *dentata*, *heterophylla* and *dictyosperma*, though some of them are common only to the eastern, others

more to the southern or western regions, and some extend only to the edges of some of the floral districts: 8 species.

2. Species peculiar to the flora of the Northern and Middle States. I refer here a single species, *E. Geyeri*, somewhat artificially it must be confessed, because it more properly belongs to the northwestern Prairie region; but thus far it has been found nowhere but in northern Illinois and in Wisconsin: 1 species.

3. Species common to Grav's and Chapman's district: 6 species.

4. Species peculiar to the southeastern flora: 8 species.

5. Species common to the southeastern and the western flora: 3 species.

6. West Indian species extending into Florida: 4 species.

7. Species peculiar to the western and southwestern Prairie flora: 19 species.

8. Species common to the last and the following region: 3 species.

9. Species peculiar to the Mountain region of the west and southwest; many of these, as well as of section 7, undoubtedly extend into Mexico: 20 species.

10. Mexican species extending into the last region: 3 species.

11. Species common to the western Mountain region and the flora of the Pacific slope: 2 species.

12. Species peculiar to the Pacific slope: 3 species.

Geographical Distribution of Euphorbiæ within the Flora of the U. States.

	1. Anisophyllum.	2. Zygophyllidium.	3. Cyttarospermum.	6. Petaloma.	9. Tithymalopsis.	10. Trichosterigma	15. Poinsettia.	26. Tithymulus 4. Ipecacuanhæ	26. Tithymulus 9. Galarrhæi.	26. Tithymulus 10. Esulæ.	Total.
1. Common to whole country,	4	–	–	–	1	–	2	–	1	–	8
2. Peculiarly northern, - -	1	–	–	–	–	–	–	–	–	–	1
3. Northeast and southwest,	2	–	–	–	–	–	–	1	2	1	6
I. Northeastern Flora. -	7	–	–	–	1	–	2	1	3	1	15
1. Common to whole country.	4	–	–	–	1	–	2	–	1	–	8
3. Northeast and southeast, -	2	–	–	–	–	–	–	1	2	1	6
4. Peculiarly southeastern, -	–	–	–	–	5	–	–	3	–	–	8
5. Southeast and west, - -	2	–	–	–	–	–	–	–	–	1	3
6. From West Indies, - -	3	–	–	–	–	–	–	1	–	–	4
II. Southeastern Flora. -	11	–	–	–	6	–	2	5	3	2	29
1. Common to whole country,	4	–	–	–	1	–	2	–	1	–	8
5. Southeast and west. - -	2	–	–	–	–	–	–	–	–	1	3
7. Peculiar to Prairie Flora, -	8	1	1	2	1	–	1	–	2	3	19
8. Prairie and Mountain Flora,	3	–	–	–	–	–	–	–	–	–	3
III. Western Prairie Flora.	17	1	1	2	2	–	3	–	3	4	33
1. Common to whole country,	2	–	–	–	–	–	2	–	1	–	5
8. Prairie and Mountain Flora.	3	–	–	–	–	–	–	–	–	–	3
9. Peculiar to Mountain Flora,	9	2	–	–	–	–	3	1	–	5	20
10. From Mexico, - - -	1	–	–	–	–	1	–	–	–	1	3
11. Mountain & Pacific Flora,	2	–	–	–	–	–	–	–	–	–	2
IV. Western Mountain Flora,	17	2	–	–	–	1	5	1	1	6	33
1. Common to whole country,	2	–	–	–	–	–	1	–	1	–	4
11. Mountain & Pacific Flora,	2	–	–	–	–	–	–	–	–	–	2
12. Peculiar to Pacific Flora,	1	–	–	–	–	1	–	–	–	1	3
V. Pacific Flora.	5	–	–	–	–	1	1	–	1	1	9
Flora of the United States.	36	3	1	2	7	2	6	6	5	12	
	51						29				80

G. E.

9. *Carex.*—In the third part of the Illustrations of Carex, by Dr. Boott (Lond. 1862, p. 119) the *C. argyrantha*, Tuckerm. (Dew. in Wood's Bot. p. 753) is referred, as stated in this Journal for May (p. 431) to the older *C. adusta*, Boott. But it appears proper to add that the same splendid work upon Carex, which is in few hands, refers (p. 118) the *C. adusta* of Carey in Gray's Manual of Botany (a plant supposed by the describer of *C. argyrantha*, without any doubt, to be Boott's) to another species, and it follows from this, on the high authority cited, that the plant called, as above, *C. argyrantha*—the true *C. adusta* of Boott—was really, as supposed by its later describer, and others, a nondescript, as respects the Manual.

The two plants here in question (*C. adusta*, Carey, l. c., = *C. fœnea*, γ, Boott, and *C. argyrantha*, Tuckerman, l. c., = *C. adusta*, Boott) are nearly akin, but they appear to be quite distinct. E. T.

Zoology—

10. *Geoffroy St. Hilaire's System of Zoology.*—The death of Isidore Geoffroy St.Hilaire, a distinguished savan and learned zoologist of Paris, was noticed in this Journal for Jan., 1862, p. 149. His system of zoology, "*Hist. nat. Générale*, Paris, 1856," is not generally known, and may be interesting to many. The synopsis which he gives of his views is short, and I present a literal translation.

"Organized bodies are distributed by St.Hilaire in three kingdoms" ..... "thus characterized."

"In the first, only the characters common to all beings, organized and living.

"In the second, the same general characters as in the first, with the addition of sensibility and mobility.

"In the third, which embraces man alone, the same general characters as in the second, with the addition of intelligence.

"In the first, life is all *vegetative.*

"In the second, to vegetative life is added *animal life.*

"In the third, to vegetative and animal life, is added *moral life.*

"And to exhibit in terms still more concise, not only this long chapter but all that precedes,

"The plant *lives;* the animal *lives* and *feels;* man *lives* and *feels* and *thinks.*

"Life is *simple* in the first kingdom, *double* in the second, *triple* in the third.

"Vegetability, animality, humanity; three terms which in this point of view succeed each other in a hierarchical order, manifestly as simple as logical—

"A series where not only no term could be transposed, but to which no term could be added." C. D.

For a synopsis of St. Hilaire's course of Lectures on Zoology see this Journal, [2] xxxii, 431.

IV. ASTRONOMY AND METEOROLOGY.

1. *Account of the great comet of* 1858, *being vol.* 3*d of the Annals of the Astronomical Observatory of Harvard College;* by G. P. Bond, Director of the Observatory, 4to, pp. 392, with 57 plates.—This magnificent volume contains a detailed account of the remarkable appearances presented

by the great comet of 1858. It is divided into XV sections. Section I contains the details of observations upon the figure, dimensions and position of the tail. The whole period of visibility of the comet extended from June 2, 1858, to March 4, 1859, an interval of 275 days. It was seen with the naked eye from Aug. 19 to Dec. 9, an interval of 112 days. The tail appeared first on Aug. 14, 1858, and was in sight until Feb. 9, 1859, or for 177 days.

Section II comprises observations upon the secondary tails. These consisted chiefly of long, narrow and nearly straight rays. They were quite faint, and escaped general notice.

Section III gives the details of the reduction of the observations upon the figure and position of the tail. The maximum length of the tail was 64° on the 10th of October; the greatest breadth was 18° on the day following.

In Section IV are considered the probable errors affecting the observations upon the tail.

Section V describes the deflection of the upper part of the tail.

Section VI describes the columnar structure, or the division of the upper part of the tail into alternating dark and bright bands, disposed transversely to the axis, at angles of 20° or 30°.

Section VII contains the reduction of observations on the secondary tails. The principal ray attained a length of 55°.

The original data relating to the envelopes and nucleus, and to the phenomena of the head of the comet generally, are comprised in Section VIII. The citations are made from 71 authorities, representing 51 stations.

The first traces of a peculiarity in the nebulosity near the nucleus, which led finally to the full development of the envelopes, were mentioned on Sept. 11th. The light was seen streaming outward from the nucleus, on the side nearest the sun, bending backward to form the two branches of the tail.

Section IX treats of the outline of the head of the comet. The discussion is based upon 123 outlines, derived from the original drawings or engraved figures. It appears that the limiting surface of the head of the comet had a close resemblance to a surface generated by the revolution of a catenary on its vertical axis.

The phenomena of the branching and central darkness of the tail have been considered in Section X. On the 24th of August, the right branch already showed an excess of light, and the contrast in density went on increasing until it reached a maximum about the time of the perihelion passage.

The size of the nucleus, and the quantity of light emitted by it and by the head generally, form the subject of Section XI. The diameter of the actual solid nucleus must have been less than 500 miles. On the 2nd of October, the brightness of the head of the comet was 6300 times greater than on June 15th, the increase by observation exceeding that computed by the usual formula, by 33 times. The difference is referred to an increase in the aggregate reflecting surface of the comet.

The phenomena presented by the envelopes are considered in Section XII. One of the most important of these is their regular succession, and

continuous ascent or expansion outwards from the nucleus. Seven distinct envelopes have been recognized, and their history partially recovered. The period between the elevation of the envelopes is found to have varied irregularly from 4 days 16 hours to 7 days 8 hours.

Section XIII gives an account of the outer faint veil.

Section XIV relates to the deviation of the initial axis of the tail from the direction of the radius vector prolonged. This deviation was estimated at 6° 18′.

This volume contains a more thorough discussion of the physical peculiarities of the comet of 1858 than has ever been published respecting any other comet; and it will probably long continue to be the standard work upon this subject. Its mechanical execution does great credit to the Cambridge press, and the engraved representations of the comet have not, so far as we know, ever been equalled by any similar work at home or abroad.

2. *Comet* II, 1862.—This comet was discovered, at the Dudley Observatory, on the evening of July 18th by Mr. Thomas Simons.

When first seen it appeared as a nebulæ considerably condensed at the centre, the light being intense enough to be easily observed when the wires of the micrometer were illuminated.

On the evening of the 31st the embryo of a tail was distinctly seen, and as early as the 25th the light was more concentrated on one side, showing that the tail was already in process of formation.

As it is now approaching both the earth and sun, and being so favorably situated for observation, it will without doubt attain great brilliancy. At the present time (Aug. 15th) the tail can be traced a distance of 12 degrees.

The following are observations for position:

	M. T. Dudley Observatory.	App. A. R.	App. Dec.
1862, July 18	$14^h\ 20^m\ 03^s{\cdot}6$	$5^h\ 23^m\ 57^s{\cdot}58$	$+67°\ 45'\ 05''{\cdot}41$
25	9 22 18 ·0	5 36 24 ·35	70° 13′ 25″·78
26	9 20 45 ·1	5 38 47 ·78	70 39 04 ·26
Aug. 12	11 05 30 ·2	8 30 51 ·50	81 20 01 ·50

July 18th. Comet compared with 10·5 Mag. star.

18 Comp. A. R. $\Delta\alpha = -6^s{\cdot}45$ 10 Comp Dec. $\Delta\delta = +55''$

The place of the star was determined by three transits at the lower culmination observed with the Olcott Meridian Circle.

1862, July 18th.	10·5° App. A. R.	App. Dec.
	$5^h\ 24^m\ 04^s{\cdot}03$	$+67°\ 44'\ 10''{\cdot}13$

The observations of July 25, 26 and Aug. 12, were made with the Olcott Meridian Circle at the lower culmination.

Fifteen wires were observed for A. R. and the times of transit recorded on the chronograph by the magnetic method.

The observations are not corrected for parallax.

G. W. Hough, *Assist. Dudley Observatory.*

Communicated by instructions from the Director.

3. *Companion to Sirius;* (in a letter to the Editors, by Lewis M. Rutherfurd.)—On the 8th of March last I received the number of your

Journal for that month, and from it learned for the first time that Mr. Clark had discovered a companion to Sirius. The evening proved a good one, and I readily saw the new companion with my equatorial, by Fitz, 11¼ in. aperture and 14 feet focal distance. My assistant, Mr. Wakely, also found the new star on the same evening in my absence. No measures were made at that time, but I find on examining the journal of the observatory the following measures recorded; they were made with a filar micrometer and powers of 200 and 400—Mr. Wakely preferring the former and I the latter:

Date.	Pos.	No. of meas.	Dist.	No. of meas.
March 11, 1862.	85° 16′	11	8″·95	1
" 12, "	not taken.		10″·93	4
" 26, "	85° 01′	10	10″·24	6
" 27, "	85° 01′	6	9″·67	3
" 28, "	85° 24′	5	not taken.	
April 3, "	85° 04′	6	not taken.	
" 10. "	84° 20′	10	not taken.	

Since hearing of the existence of this star I have never looked for it in vain; its difficulty is not occasioned by faintness, but by its proximity to so bright an object as Sirius. I consider it decidedly a brighter star than either of the close companions in the trapezium of Orion—no reasonable amount of illumination in the field extinguishes it. On the 6th of April, within five minutes after sunset, I set the circles of the equatorial and found Sirius, the daylight being abundant to read the divisions, the companion was then quite distinctly visible; and on the 10th of April Mr. Wakely's measures were taken by daylight.

From these circumstances I should be inclined to think this new star variable, since it has hitherto escaped the scrutiny of many observers armed with sufficient optical power to see it; or perhaps it must be added to the long list of evidences, that it requires a far greater power to make a new discovery than to recognize it when known.

New York, July 28, 1862.

4. *The Meteors of August 10th*, 1862.—It is probable that the full moon which occurred this year at the August period has interfered to a great extent with the usual observations. There are, however, certain respects (photometric especially) which confer special value upon the phenomena as exhibited through a screen of mild light just sufficient to obliterate the faint lines and leave none visible but the stronger and more brilliant. The records which have thus far reached us the present month come from the observers, Mr. B. V. Marsh and Mr. F. W. Russell. The station of the latter the present year was Winchendon, Mass., lat. 42° 40′, lon. 72° 12′. We remark, in anticipation of the observations given below, two points especially:—

First. The radiant on the morning of the 9th, although determined by only a few flights, is stated decidedly as a circle of "5° diameter, including delta Cassiopeiæ." But on the morning of the 10th it was "in A. R. 41° 40′, and N. P. D. 35° 15′." This change of position, although excessive, coincides—to a near parallelism—with the changes marked and suggested, as an invariable phase of these phenomena, upon our frag-

mentary chart given last year at p. 445 of vol. xxxii. The subsequent observations of the record do not particularly confirm this motion; neither are they sufficiently definite to discredit it.

Second. One meteor appeared "in the radiant" as "a stationary point of brightness." This is a fourth instance added to the three narrated in connection with our chart above specified. A phenomenon thus repeatedly witnessed certainly deserves attention, on account of the overwhelming improbability that either meteor of so limited a number should be directed so exactly in the line of vision.

Mr. Russell's record is the following:—

"*Saturday, Aug. 9th.*—One hour. Two to three o'clock, A. M., 8 meteors, with radiant a circle of 5° diameter including δ Cassiopeiæ.

The moon being nearly full embarrassed the view, as did also the mist. The meteors seen were embraced in a circle of 30° or 40° radius about Perseus. All but one or two radiated about the constellation Cassiopeia but exhibited no decided *point*. Perhaps a large circle of 5° diameter, including δ, would embrace five or six of the flights.

Sunday, 10th.—Two observers—W. G. Bryant and myself. 2h to 3h, 40 meteors. 3h to 3h 40m, 50 meteors. 1h 40m, 90 meteors. The radiant I determined to be a circle of 1° 55′ to [1°] 59′ radius, having its centre very nearly in A. 41° 40′ R. and N. P. D. 35° 15′, or very nearly in centre of triangle formed by η-γ-k Persei of Burritt's maps. About one-third of the meteors were in the N.E. and the remainder in the N.W. Of the meteors which I observed in the east all but two were conformable, or at least approximately conformable. Of the last none passed more than one or two degrees outside of the circle. The largest meteor perhaps equalled Mars in brightness, 15 having trains. *A stationary point of brightness was observed in the radiant* once. This radiant conforms very closely to that of 10th and 11th of Aug., 1861, as stated by B. V. Marsh. (This Journal, Sept., 1861.)

P. M.—Began observing at 9h. 9h to 10h in east 13, all but one conformable, in west 10, one with train. 10h to 11h in east 6, in west 4, all small. Shortly after the latter hour the clouds, which had been increasing since 9h, caused so much embarrassment that the watch had to be given up. Those meteors seen after 9h appeared to radiate from the position of the previous morning, but the clouds prevented any very accurate determination of its exact position. Besides the above, while we were arranging for the watch, we saw seven of the largest meteors of the evening, two with trains, all radiating from Cassiopeia.

Resume.—10th of Aug., 8h 40m to 11 P. M.—2h 20m—40 meteors. Of 20 all but two conformable, three with trains. Evident radiant same as previous morning.

Monday, 11th.—One hour. 8h to 9h P. M. 4 meteors. One with train, three radiating from near δ Cassiopeiæ, and the other (the first observed) nonconformable.

Clouds prevented observations on the mornings of 11th, 12th and 13th. On the evening of 13th saw two meteors, within a few minutes, radiate from Perseus. This shows that the thickness of the "ring" is probably near twelve millions of miles, the earth being six or seven days in passing through it."

Upon the above record we remark farther that whether the ninety meteors seen on the morning of the 10th by two observers in $1^h\ 40^m$ are to be divided equally between the two to obtain the rate for a single observer is not clear; because it is not stated whether their attention was directed to the same or to different quarters or spaces of the heavens.

The following valuable observations have been furnished, as made by himself, by Mr. Benj. V. Marsh in a letter to Prof. H. A. Newton:

Meteors observed at Germantown (near Philadelphia), Pa.

"1862, Aug. 11. From $0^h\ 30^m$ to $1^h\ 0^m$ A. M., 11 meteors.

1	0	"	1	15	"	4
1	15	"	1	30	"	1
1	30	"	1	45	"	5
1	45	"	2	0	"	3
2	0	"	2	15	"	7
2	15	"	2	30	"	4
2	30	"	2	45	"	4
2	45	"	3	0	"	7
3	0	"	3	15	"	1
3	15	"	3	30	"	4

Total, 51 meteors in 3 hours.

Weather perfectly clear, full moon shining.

Nearly all the above were conformable—approximately at least—only two being observed that were certainly altogether unconformable, but the direction of motion in several was uncertain because of the shortness of their path and their not being in the direction to which the principal attention was directed.

The most brilliant were as follows:

At 0 $26\frac{1}{2}$, north of Capella.
0 $28\frac{1}{2}$, in the north.
2 10, near β Persei—splendid—left a wavy streak which was visible 5 or 6 seconds.
2 16, near β Persei—streak lasting 1 to 2 seconds.
2 34, in S.E.—streak lasting 1 or 2 seconds.
3 $2\frac{1}{2}$, in Cassiopeia.
Much the finest was at 2 10."

It is greatly to be desired that some of the meteors above reported by Mr. Marsh (particularly the $2^h\ 10^m$ near β Persei) may be identified by observers at other places. If any observer suspects an identity with his own, in this or in either of the instances, he is invited to communicate all the particulars of his observations,—as Mr. Marsh is understood to have corresponding particulars on record with which a comparison may be made.

ALEX. C. TWINING, *for the Com. of Conn. Academy.*

5. *On some North American Meteorites;* by C. F. RAMMELSBERG.—Rammelsberg has communicated to the Berlin Academy of Sciences an examination of the meteoric stone from Bishopville, South Carolina. His results differ materially from those obtained by Shepard and Sartorius von Waltershausen. He concludes that the siliceous portion of the stone is not a simple compound, but probably a mixture, and that the assumption that it contains a supposed trisilicate of magnesia ($\dot{M}g\ \ddot{S}i$)—the chladnite of Shepard—is not justified by the observed facts. His analysis of the stone gave,

$\ddot{S}i$	$\dot{A}l$	$\dot{F}e$	$\dot{M}n$	$\dot{M}g$	$\dot{C}a$	$\dot{N}a$	$\dot{K}$	Ign.
57·52	2·72	1·25	0·20	34·80	0·66	1·14	0·70	0·80=99·79

Rammelsberg observes that this composition somewhat resembles that of the olivine-like substance from the Grimma meteoric-iron analyzed by Stromeyer in which the latter found $\ddot{S}i$ 61·88, $\dot{M}g$ 25·83, $\dot{F}e$ 9·12, $\dot{M}n$ 0·31

$\dot{F}r$ 0·33, Ign. 0·45=97·92. The resemblance is more marked, if the protoxyd of iron in the analyses be converted into its equivalent weight of magnesia.*

Rammelsberg also presented to the Academy, the results of the examination of three so-called meteorites, which Dr. Hörnes of Vienna, had received from Prof. C. U. Shepard of Amherst College. In communicating the specimens to Rammelsberg, Dr. Hörnes remarks that they are certainly *not* meteorites. The results were as follows:

I. *So-called Meteoric Stone from Waterloo, Seneca County, New York.*—According to Shepard it contains: $\ddot{S}i$ 78·8, $\dot{A}l$ 6·28, $\dot{F}e$ 8·72, $\dot{H}$ 4·75, $\dot{C}a$, $\dot{M}g$ (in equal quantities!) and loss 1·45. Rammelsberg considers that this is without doubt nothing more than a ferruginous clay. It is for the most part decomposed by chlorhydric-acid, contains much more alumina than above indicated, and 6 pr. ct. of water. On heating it becomes brick-red.

II. *So-called Meteoric Stone from Richland, near Columbia, South Carolina.*—It is a yellow to gray mass, showing occasional blackish points, and small lustrous kernels of what appears from the hardness to be quartz. Analyses by Shepard and Rammelsberg gave,

$\ddot{S}i$	$\dot{A}l$	$\dot{F}e$	$\dot{M}g$	$\dot{C}a$	Ign.		
80·42	15·68	2·79	0·70	0·50	——	= 100·09	Shep.
70·42	20·25	3·86	4·47	1·21	1·28	100·49	Ramm.

Rammelsberg found that chlorhydric acid had very little action on the substance. He considers that this is also a clay, and suggests that perhaps it is a fragment of a brick.

III. *So-called Meteoric Iron from Rutherford, North Carolina.*—This mass, in which Shepard found, Fe 84·00, Si 13·57, P 1·31, and according to a partial analysis made in Wöhler's Laboratory contains, Fe 87·1, Si 10·6, C 0·4, is considered by Rammelsberg as nothing more than a piece of white pig iron of inferior quality. He found it difficultly attacked by acids and determined it to contain 15·7 pr. ct. of silicon.—*Journal für praktische Chem.*, lxxxv, 87. G. J. B.

6. *Bullettino Meteorologico dell' Osservatorio del Collegio Romano* con Corrispondenza e bibliografia per l'avanzamento della fisica terrestre. Roma, March 1st, 1862—bi-weekly.—We have received the first 10 numbers of this Meteorological Journal published at Rome, Italy. The Nos. are issued once a fortnight, each No. consisting of eight large quarto pages, beautifully printed. They contain the meteorological, magnetic and electric observations made at the Roman College under the direction of Father Secchi, with full meteorological notes, and also dissertations upon various questions relating to terrestrial magnetism, to atmospheric electricity, the electric currents, the atmospheric pressure and temperature. We anticipate much valuable information from this new vehicle of meteorological science.

* From some investigations made by Prof. J. Lawrence Smith he had been led to think that chladnite might possibly prove to be a pyroxene. See this Journal, [2], xix, 163.

V. MISCELLANEOUS SCIENTIFIC INTELLIGENCE.

1. *Editorial Correspondence—The Spectroscope.*—The following letters from Professors Cooke and Rood contain interesting observations with the spectroscope, which is hereafter to be regarded as an indispensable auxiliary in the working laboratory. The instrument of Mr. Clark, with which Prof. Cooke's observations were made, has a prism of flint glass of about four inches on each face which is built up of several thicknesses of plate glass cemented together by Canada balsam. This construction facilitates the use of a large prism at a small cost, and the lines of junction are of no optical importance.

Cambridge, July 28, 1862.

My dear Silliman:—I have a few moments, before leaving Cambridge for the vacation, to make good my promise and give you the results of my experiments with Clark's spectroscope. It has worked wonders in splitting up the various colored bands of the different spectra. You know that the yellow sodium band is doubled. I have succeeded in separating them, at least a sixteenth of an inch still retaining good definition. The red line of potassium is also double, the two members being even wider apart than those of sodium. The red lithia line, I think, is also double, but it is possible that I may here be deceived by the effect of diffraction similar to that described by Dr. White in a late number of your Journal. The most remarkable result is that with the broad orange band of strontium. It divides up into a large number of bands or rather it appears as an orange space covered by a large number of black lines apparently perfectly similar to the Fraunhofer lines. On many of the other bands I have caught glimpses of similar lines, but the light has been so feeble that the results have not been equally satisfactory. In order to see them it is necessary to reduce the width of the slit to about the same size as that required to show the Fraunhofer lines, but with the ordinary appliances long before this point is reached the light from most of the bands has become too feeble to be perceptible. I find that by flashing the salts into the flame the intensity of the light is greatly increased and I hope I may in this way succeed in figuring the dark lines of the salt spectra at least tolerably well. The colored bands of these spectra are therefore no longer to be regarded as bands of light complementary to the Fraunhofer lines, but as colored spaces themselves crossed by dark lines. The bearing of these facts on the ingenious solar theory of Kirchhoff and Bunsen is evident. Very truly, your friend,

Josiah P. Cooke, Jr.

2. *On prisms of Bisulphid of Carbon for optical purposes*, (from a letter of Prof. O. N. Rood to Prof. B. Silliman, Jr.).

Dear Professor:—I send you a stereograph of a large spectroscope with *four prisms*, which I have lately constructed for use in my optical studies. While the general arrangement is similar in principle to that employed by Kirchhoff in his large instrument, the construction of the prisms is peculiar and may be of interest to you. Three of the prisms are hollow, and filled with bisulphid of carbon, the fourth is of flint glass, the angles being respectively, 60°, 60°, 60°, and 45°. The frames of the prisms were made of cast iron; after the faces had been worked nearly true, plane, parallel plates of glass were cemented on the sides with a mixture of glue and molasses. After a few days bisulphid of carbon was poured in through an opening which was then closed by a screw. So far the construction was old, and attended with a most serious defect which has perhaps prevented the general introduction of these prisms, for if the light from the slit be allowed to fall on a face of a prism thus prepared, and reflected from it along the axes of the observing telescope, it will

be found that the image of the slit is *distorted* to a greater or less degree; farther examination shows that the glass plate has been slightly bent by the hardening of the glue, and in those of my preparation the curvature was concave. If two or more such prisms are used for the production of a spectrum a certain amount of confusion is always seen among the fixed lines; plates of glass of even $\frac{1}{10}$ of an inch in thickness are constantly affected in this manner, and unless the evil be removed the prisms are of no great value.

After many vexatious failures I have perfectly corrected this difficulty in a very simple manner: the prisms are finished in the way above described with glass of good quality, then a few drops of olive oil are placed on one of the faces and a plate of truly plane glass laid on it; the oil spreads out and is held in position by capillary attraction, the four corners are then secured by four drops of melted wax and resin. Optical contact is thus secured, and the slight curvature corrected: each face is in turn thus dealt with. The substitution of Canada balsam for oil I have also tried, but it is impossible under several months to offer any opinion on its merits. Large prisms of bisulphid of carbon thus corrected, while remarkably cheap, approach, I think, a degree of optical perfection not attainable by the best flint glass prisms yet produced, for even if the flint prism is of equal size with that of bisulphid of carbon, and optically unexceptionable, the fact still remains that the dispersive power of the latter is greater.*

With three such prisms of 60°, and a flint glass prism of 45°, a ray of light is refracted about 180°, a spectrum furnished which with the power I employ is ten feet long, the lines being as clear and sharp as those in an engraving, while the light is more than abundant. In examining the solar spectrum with this apparatus I have discovered many lines not laid down in Kirchhoff's new and most admirable chart of the solar spectrum; I mention now merely two new lines in the interior of the line D, making in all three fine lines which are enclosed in this double line.

Encouraged by the excellent performance of these prisms, I am now engaged in constructing for my investigations a large instrument in which the refraction is to be effected by from eight to ten of these prisms, carrying thus into effect a suggestion made by Kirchhoff some few weeks ago in his paper on the solar spectrum.

Before closing this letter one practical point remains to be alluded to: it is not essential that the plates of glass should have truly *parallel* sides, provided that the plates are cut in such a manner that their plane of refraction coincides with the plane of refraction of the prism.

Sincerely,

Troy, Aug. 7th, 1862. O. N. Rood.

3. *Ascent of the Volcano of Candarave, Peru*, (about lat. 18° S., lon. 70° W.), in a letter from Walter Stuart Church, Esq., Civil Engineer in the service of the Peruvian Government.—"We made the ascent of the volcano of Candarave on Monday, the 12th of May with the Arriéro and Lieut. Governor of Candarave. Finding that it would be too much for a single day, we started at 2 o'clock on Sunday to seek lodgings at the base. The Governor was backing out at the last moment, when we found an opportune auxiliary in a Padre, who returning from mass stopped to give us directions about the best road, and urged the Governor to go with us. The Indian villagers however gathered about us, smiling at our making

* While in Munich in 1857, I requested Prof. Steinheil to give me a flint glass prism having the greatest attainable dispersive power. He furnished me at once with a prism which had what might be called an impracticably high dispersive power, stating that it was a failure, the amount of oxyd of lead being so great that the surfaces tarnished in a very few months. I have compared this prism with bisulphid of carbon prisms, and find that the dispersive power of the latter is greater.

an attempt in which we should be sure to fail, for the mountain, according to tradition, "would *swallow* us." At sunset we reached a single Indian hovel well up the mountain. Its only inhabitant was a little child of some ten years, who was much terrified at our approach and cuddled under the bed-clothes to have a cry, but the offer of bread, which it devoured voraciously, and kindly treatment pacified it. The mother (an imbecile) had gone 10 miles for squashes and would not return for a day or two. We removed the cobble-stones piled in the door way of the hut, and made ourselves at home, as best we could. Our stupid cook had by mistake substituted tobacco for coffee, forgot the tea altogether, and put the milk into a dirty can which had soured it, so our precautions for a comfortable meal were futile. However, the arriéro got up a savory "chupe," while Delgardo and I amused ourselves looking on. An old Indian traveler happened along, and joined our chowder-party, greatly surprised at encountering us. The Governor pressed him for our guide next day, as by his account we were much off our road.

The night was a remarkably mild one at an elevation of 12,850 feet, and at 6 the next morning we were in the saddle climbing the mountain's base. We pushed the poor beasts to their utmost capacity, far above the snow-line, among the Andes' lilies, and balls of hard sponge-like looking moss, and passing to the N.W. escaped the deeper snow, which in all these sierra is melted almost entirely from the inland side, by the warmer winds. We attained at 20 minutes to 9 the very cone where the sandy sides were interrupted by a mane of ragged rocks. Here the Indians stopped, and neither persuasion, bribes nor threats would make them budge. They valued their lives more than anything else, and we were sure to be "swallowed" if we went up. They would hold the beasts—watch us, and offer ovations of coca to the mountain Deity for our safe return! So away we went on foot, climbing very slowly over the loose rocks, and resting at short intervals to enjoy the scene, which became grand beyond description. Three long hours and more we struggled up—the path growing steeper and steeper, until 12 M., when we stood on the lowest edge of the crater's lip, broken away by the huge rocks it had heaved out. Respiration became difficult, and the poor arriéro could hardly move. I carried the barometer, fearing to trust even my companion with it. They told me I was very pale; it certainly required great effort to climb round the rising edge of the great hole we had reached, to a bluff, forming its summit, when directly the "Soroche," or "Puna," as the natives call it, overcame me. This affection is very similar to sea-sickness—it attacks some persons very violently, belching blood from nose and ears."

[Baron Tschudi says of this affection—"In the heights of the Cordillera the effect of the diminished atmospheric pressure on the human frame shows itself in intolerable symptoms of weariness and an extreme difficulty of breathing. The natives call this malady the *Puna* or the *Soroche*, and the Spanish Creoles give it the names of *Mareo* or *Veta*. Ignorant of its real causes they ascribe it to the exhalations of metals, especially antimony, which is extensively used in the mining operations. The first symptoms of the Veta are usually at the elevation of 12,600 feet above the sea. These symptoms are vertigo, dimness of sight and hearing, pain in the head and nausea. Blood flows from the eyes, nose, and lips.

Fainting fits, spitting of blood, and other dangerous symptoms, usually attend severe attacks of Veta. The sensations which accompany this malady somewhat resemble those of sea sickness, and hence its Spanish name *Mareo.* But sea-sickness is unaccompanied by the distressing difficulty of breathing experienced in the Veta. This disorder sometimes proves fatal, and I once witnessed a case in which death was the result."*]

I had fortunately but a slight attack, and soon felt relieved enough to take an observation, which, to our great surprise, showed us to be 18,962 feet above the sea—more than 3000 feet higher than Mount Blanc and 250 higher than the "*Misty*" near Arequipa, as measured by Humboldt. Our view had widened into a command of the whole sierre and its ramifications, hundreds of miles in area. To the south and west lay the lagoon of Candarave,—our mountain road back to Tacna, joined on the east by a long ridge, over which ran a water course (Acquia) to the volcano of Zutupaca,—the snow-tops running towards Arequipa. Northward stretched the Alto of Puma, and northeast, the red rocks of the Machita Pass peeping out from the snow in strong contrast. Just above Tarrata, nearer our base, we saw the several Quebradas, furnishing outlets for the thaws through the rivers Totona, Caijasso and Pasto Grande—and away beyond all, the blue sea, which *they never reach*, being quite dissipated in irrigation.

There was little interesting in the crater itself, dormant some 83 years—no lagoon or birds, as reported, only a little frozen puddle, the drainage of a diameter of some 400 feet, and a depth of perhaps 100—and only two or three small bits of sulphur. Descending we took the sand or volcanic ashes which, as on Vesuvius, lie at a steep angle of repose, making an easy path for the weary climber on his return. Behind lie two smaller peaks from which the Indians gather sulphur for market. In the base of the nearest is a huge hole, which but for its elevation we should have supposed to be the entrance to a mine, the vent perhaps of a lateral eruption. Towards it we traced the huge tracks of a cougar. We continued on foot to the Indian hovel, which we reached at sunset—the little child was gone. We mounted our mules just as the full moon rose and reached the village, 12 miles off, at 6½, A. M."

4. *Retorts.*—The retort is one of the chemist's most useful instruments, and yet, while such great improvements have been introduced into chemical apparatus generally, it is still made of the old shape, with little or no variation.

With very little additional trouble, our glass houses might make retorts such as would be of the greatest convenience to chemists. In a great many operations the stem of the retort is raised, so that liquids may flow back, and only gases pass over: in these cases it is difficult to make a tight fit with a cork, inasmuch as the latter only touches the glass at a single line, and if much force is used the glass breaks. Retorts should be made for this express purpose, with the stem finished like the neck of a flask. Again, flat-bottomed flasks have almost entirely taken the place of round-bottomed; why should we not have flat-bottomed retorts? Then too when dry substances are to be distilled, it would be convenient to have retorts with their tubes diminishing to quite a small size, in order to be connected by india rubber tube with ordinary sized glass tube.

* Travels in Peru, p. 207, (American edition).

This form would also be convenient for the purposes first above referred to. It is true that this last form is often given to the necks of retorts by the chemist himself with the blowpipe. But it would be convenient to have the time saved which is wasted on this mechanical work, and it would be better done in the glass-house. Any manufacturer who would give his attention to these matters would confer a benefit on chemists, and would doubtless find his account in doing so. M. C. L.

5. *Old friends with new faces.*—Sometime since it was urged that the word "telegraph" as applied to the dispatch sent was ambiguous and liable to be mistaken for the instrument itself, and the new word "telegram" was coined to remove the objection. Somewhat reluctantly the new comer was admitted, and now we are asked to consent to "photograms."* If we assent to this innovation how can we object to paragrams, autograms and lithograms?

OBITUARY.

Marcel de Serres died on the 22d of July at Montpellier (France) in the 82d year of his age. He was a corresponding member of the Academy of Sciences at Paris, and Professor of Geology in the Faculty of Sciences at Montpellier. He belonged to the same family with the celebrated Agriculturist, Olivier de Serres, a family famous in civil life, he himself having exercised the functions of a Councilor from 1814 to 1852, and published a work in 3 volumes entitled: *Manuel des Cours d'Assises.* But his reputation rested chiefly upon his scientific labors, especially in the department of philosophical natural history. He belonged to a class of *Savants* rare now-a-days, who embraced at one grasp all branches of science, seeking rather to illustrate one by another than to apply himself exclusively to advancing the progress of one alone. He thus studied plants and animals in their mutual relations to both living and fossil species, the laws of the succession of species on the globe, their geographic distribution, and in some cases their anatomy as well as their physiology. His original researches embrace a wide range, e. g., in comparative anatomy we have his Memoir on the eyes of Insects; in Geology and Palæontology are his researches on Caverns and their bones; and those in the Tertiary deposits. He published an extended work on the Mosaic Cosmogony and its relation to Geology, and others on pure Geology and Mineralogy, while his *Mémoirs sur les terrains du midi de la France* occupy an important place in the history of Geology. He was the pupil of the most distinguished masters of the last generation, of Haüy, Alex. Brongniart and of the leaders in moral and ethical sciences, having been originally destined for the church. A commission from Daru, *intendent général* of the great army then in Austria, called him in May, 1809, to Vienna as inspector of Arts and Manufactures, a commission which resulted in great benefit to the arts, manufactures, agriculture and commerce of France. The new documents which he collected during this military journey furnished the material of sixteen volumes, which appeared under various titles from 1814 to 1823. He was a man of vast industry and untiring energy, filling with exactness his post as Councilor of the Court, he discharged with zeal his duties as Professor, printing at the same time in the Scientific Journals, memoirs on zoology, palæontolology, geology, while he published in

* Sabine, Phil. Mag. Dec., 1861, p. 479.

the industrial Journals details relative to processes upon which he had collected notes. Few men have lived whose existence was more completely filled than that of Marcel de Serres; few savants have displayed greater activity and found themselves in a position so favorable to render service to science. With mere ambition, and in another field, he might have reached a high station in the State, but his desires were not in the direction of political distinction. Simple in his tastes, kind and polished in his relations, more devoted to science than sensible to the honors to which it led, he seemed neither to doubt or to cultivate his own reputation; happy without applause and famous without ostentation.

H. H. DE SENARMONT: died very suddenly (aged 56 years) at Paris on the 30th of June at 2½ o'clock A. M., of syncope consequent on inveterate gout. The appreciation of his loss was such in Paris that the Academy of Sciences immediately adjourned on hearing of the decease of their distinguished associate. To quote the words of the Secretary, "In the state of general consternation which this unexpected news had produced on the Academy and upon the public which had come in to attend the session, they could think of nothing but their sad loss. Therefore on the motion of Messrs. Chevreul and Combes, who appeared as the organs of the public grief, the assembly dispersed, the prey of the most lively emotion."

His death leaves a great void in the Academy. He will be keenly missed by all the younger men of science whom he loved to encourage and of whom he was the eloquent advocate.

Mr. de Senarmont was Professor of Mineralogy in the School of Mines at the time of his death.

Dr. HENRICH GEORG BRONN: Professor of Natural History in the University of Heidelberg, Baden, died suddenly of disease of the heart at 3½ o'clock, P. M., on the 5th of July, in the 62d year of his age. This death is a great loss to science. Dr. Bronn was a most successful and laborious author in Palæontology. Since 1824 his contributions to Zoology, Geology, Mineralogy and Palæontology have been unceasing. The list of titles of his contributions in zoology and geology alone in Agassiz's Biblig. Zoolog., reaches thirty-eight, up to 1848, only. His great work *Lethæa Geognostica*, appeared in a new edition from 1851 to 1856. Since then he has been chiefly occupied with an elaborate illustrated Treatise entitled, "Die Klassen und Ordnungen des *Thier-Reichs* wissenschaften dargestelt in Wort und Bild."

This remains incomplete, the last part which has reached us being No. 16 of the 3d volume, containing Malacozoa.

His *Index Palæontologicus*, 3 vols., 1848–49. Part 1st, *Nomenclator palæontologicus*, A–Z, pp. 1381 and Pars 2d, *Enumerator palæontologicus*, pp. 980, is one of those works of vast and exhausting labor which few have the courage or knowledge to undertake, but the value of which, as of a good lexicon is inappreciable: would it could be brought down to date!

On the 23d of January, 1862, he lost his old teacher, colleague and co-editor, Prof. Leonhard. The Journal (Neues Jahrbuch für Mineralogie, Geologie, etc., Heidelberg, 1830–1862) so long associated with the names of Leonhard and Bronn, will be continued by the same title and under the same names. Prof. Bronn leaves two sons, Leopold and Henrich G.

General Isaac I. Stevens, U. S. A., was killed in an engagement near Fairfax Court House, Virginia, Sept. 1, 1862. His labors in the explorations and surveys on the 49th parallel north latitude, when Governor of Washington Territory, form a valuable addition to our knowledge of the Physics and Geography of the North American continent.

VI. PROCEEDINGS OF SOCIETIES.

Proc. Boston Soc. Nat. Hist. (continued from p. 304, vol. xxxiii) 1861. Vol. viii. —NOVEMBER.—224, The Acalephan Fauna of the southern coast of Massachusetts (Buzzard's Bay); *Alex. Agassiz* (oral communication).—226, Homologies of Radiata; *L. Agassiz.*—233, Chemical analysis of a Meteoric Stone from Dhurmsalla, India; *C. T. Jackson.*—235, On the Homologies of Echinoderms; *L. Agassiz.*—239, The Taconic and Lower Silurian Rocks of Vermont and Canada; *J. Marcou.*—253, Note on cleaning Diatomaceæ; *Arthur M. Edwards.*—255, On Melania (Amnicola) Lapidaria; *James Lewis.*—256, Preparation of the bones of a supernumerary leg from a goose; exhibited by *Prof. Wyman.*—257, Report of the Building Committee, presenting a plan for the New Hall of the society, fire-proof, spacious, and convenient for the Library and Cabinet, to cost about $62,000.—258, Specimen of Domeykite from the vicinity of Portage Lake, Lake Superior; presented by *Dr. C. T. Jackson.*—258, Account of 27 specimens added to the department of Comparative Anatomy: being the animals suffocated by smoke from a fire in Goodwin's Menagerie; *Dr. T. C. White.*—DECEMBER.—261, On new Genera and Species of Starfishes of the family Pycnopodidæ (*Asteracanthion* Müll. and Trosch.); *William Stimpson.*—273, Descriptions of two new species of Shells; *Temple Prime.*—274, Lateral symmetry in Brachiopoda; *N. S. Shaler.*—280, Descriptions of new Genera and Species of Shells; *A. A. Gould.*—284, Discussion on the depth at which animal life exists in the sea; *Marcou, Gould, Agassiz,* and *Dr. J. Pickering.*—285, On the eyes of a Horse Mackerel, exhibited by *Dr. B. J. Jeffries.*—285, On the geology of Anticosti Island, in the Gulf of St. Lawrence; *N. S. Shaler.*—289, Observations upon the Rocks of the Mississippi Valley which have been referred to the Chemung Group of New York, together with Descriptions of New Species of Fossils from the same horizon at Burlington, Iowa; *C. A. White* and *R. P. Whitefield*—Vol. ix, 1862. JANUARY.—2, On the Structure of the valve of the Diatomaceæ; *Charles Stodder.*—FEBRUARY.—8, Description of new species of Fossils from the Devonian and Carboniferous Rocks of the Mississippi Valley; *Charles A. White,* of Burlington, Iowa.

Proceed. of Acad. Nat. Sci. Philad., 1861 (continued from vol. xxxii, p. 160). —DECEMBER.—p. 391, Descriptions of Eleven new species of the genus Unio from the United States; *Isaac Lea.*—393, Descriptions of seven new species of the genus Io; *Isaac Lea.*—394, A revision of the species of Baculites, described in Dr. Morton's "Synopsis of the Cretaceous group of the United States;" *W. M. Gabb.*—396, On the Mollusca of Harper's Ferry, Virginia; *Geo. W. Tryon, Jr.*—399, On Squalus Americanus, Mitchell, referring it to the genus Odontaspis, Agassiz; *Chas. Conrad Abbott.*—402, Monograph of the species of Sphærium of North and South America; *Temple Prime.*—409, Descriptions of new Palæozoic Fossils from Kentucky and Indiana; *Sidney S. Lyon.*—414, Descriptions of three new species of Mollusca of the genus Sphærium; *Temple Prime.*—415, Descriptions of new Lower Silurian (Primordial), Jurassic, Cretaceous, and Tertiary fossils, collected in Nebraska, by the Exploring Expedition under the command of Capt. Wm. F. Raynolds, U. S. Top. Engrs.; with some remarks on the rocks from which they were obtained; *F. B. Meek* and *F. V. Hayden.*—448, Description of New Plants from Texas; *S. B. Buckley.*—463, Description of a new Quadrumanous Mammal, of the genus Midas; *J. H. Slack.*—465, Synopsis of the recent species of Gastrochænidæ, a family of Acephalous Mollusca; *Geo. W. Tryon, Jr.*—494, On the genera Panolopus, Centropyx, Aristelliger and Sphærodactylus; *E. D. Cope.*—501, Synopsis of the Sillaginoids; *Theodore Gill.*—505, Description of a new species of Sillago; *T. Gill.*—507, Synopsis of the Chænichthyoids; *T. Gill.*—510, Synopsis of the Harpagiferoids; *T. Gill.*—512, Synopsis of the Nototheniоids; *T. Gill.*—522, Observations upon certain Cyprinoid fish in Pennsylvania during the summer of 1861: oral communication; *E. D. Cope.*—524, Remarks of the Ailanthus Silkworm: oral communication; *Dr. Stewartson.*

1862. JANUARY.—p. 2, Notes on some of the American Ash trees (Fraxinus),

with descriptions of new species; *S. B. Buckley.*—5, Descriptions of new plants from Texas: No. 2; *S. B. Buckley.*—10, On the uniformity of Relative Characters between Allied Species of European and American Trees; *Thos. Meehan.*—13, Notice of a new species of Hemilepidotus, and remarks on the group (Temnistiæ) of which it is a member; *T. Gill.*—14, On the subfamily of Argentininæ; *T. Gill.*—15, Appendix to the Synopsis of the subfamily of Percinæ; *T. Gill.*—16, Note of the Sciænoids of California; *T. Gill.*—FEBRUARY.—21, Descriptions of new Cretaceous fossils from Nebraska Territory, collected by the expedition sent out by the Government under the command of Lieut. John Mullan, U. S. Topog. Eng., for the location and construction of a wagon road from the sources of the Missouri to the Pacific Ocean; *F. B. Meek* and *F. V. Hayden.*—28, Monograph of the species of Sphærium of North and South America; *Temple Prime.*—38, Note on the classification of Cerambycidæ, with descriptions of new species; *John L. LeConte.*—43, Synopsis of the Mordellidæ of the United States; *John L. LeConte.*—52, Note on the species of Calosoma inhabiting the United States; *John L. LeConte.*—54, Descriptions of certain species of Diurnal Lepidoptera found within the limits of the United States and British America: No. 2; *Wm. H. Edwards.*—58, Description of a new Cardium from the Pleistocene of Hudson's Bay; *Wm. Stimpson.*—59, Additions to the nomenclature of North American Lepidoptera; *Aug. R. Grote.*—60, Synopsis of the species of Holcosus and Ameiva, with diagnoses of new West Indian and South American Colubridæ; *E. D. Cope.*—82, Monograph of the species of Trogosita, inhabiting the United States; *Geo. H. Horn.*—88, Descriptions of Plants: No. 3; *S. B. Buckley.*—100, Note No. 2: On Quercus heterophylla, Mich.; *S. B. Buckley.*—MARCH.—102, Synopsis of the family of Cirrhitoids; *T. Gill.*—122, Description of a new species of Cirrhitus (*Cirrhitus alternatus*); *T. Gill.*—124, On the limits and arrangement of the family of Scombroids; *T. Gill.*—127, Descriptions of new species of Alepidosauroidæ; *T. Gill.*—132, On a new species of Priacanthus discovered in Narragansett Bay, R. I.; *T. Gill.*—133, On an oceanic Isopod found near the southeastern shores of Massachusetts; *Wm. Stimpson.*—134, On the West African genus Hemichromis and descriptions of new species in the Museums of the Academy and Smithsonian Institution; *T. Gill.*—140, Catalogue of the Fishes of Lower California in Smithsonian Institution, collected by Mr. J. Xantus; *T. Gill.*—151, On some new and little known American Anura; *E. D. Cope.*—APRIL.—161, Notes upon the "Description of new plants from Texas, by S. B. Buckley," published in the Proceedings of the Academy of Natural Sciences, Dec. 1861 and Jan. 1862; *Asa Gray.*—168, Descriptions of ten new species of Unionidæ of the United States; *Isaac Lea.*—169, Description of a new genus (Trypanostoma) of the family Melanidæ, and of forty-five new species; *Isaac Lea.*—176, Description of two new species of exotic Uniones and one Monocondylœa; *Isaac Lea.*—176, Contributions to Neotropical Saurology; *E. D. Cope.*—188, On Neosorex albibarbis; *E. D. Cope.*—189, On Lacerta echinata and Tiliqua dura; *E. D. Cope.*—191, On the classification and synonymy of the recent species of Pholadidæ; *George W. Tryon, Jr.*—221, Descriptions of certain species of diurnal Lepidoptera, found within the limits of the United States and of British America: No. 3; *Wm. H. Edwards.*—226, Synopsis of the North American forms of the Colymbidæ and Podicipidæ; *Elliott Coues.*—233, On a new genus of Fishes allied to Aulorhynchus and on the affinities of the family Aulorhynchoidæ, to which it belongs; *Theodore Gill.*—235, Remarks on the relations of the genera and other groups of Cuban fishes; *Theodore Gill.*—242, Catalogue of the Fishes of Lower California in the Smithsonian Institution, collected by Mr. J. Xantus: Part II; *T. Gill.*—246, Descriptions of two new species of Vespertilionide, and some remarks on the genus Antrozous; *Harrison Allen.*—MAY.—249, Catalogue of the Fishes of Lower California in the Smithsonian Institution, collected by Mr. J. Xantus: Part III; *T. Gill.*—262, Description of a new genus (Goniobasis) of the family Melanidæ and eighty-two new species; *Isaac Lea.*—JUNE.—272, Descriptions of eleven new species of Melanidæ of the United States; *Isaac Lea.*—274, Notes of a collection of the Fishes of California presented to the Smithsonian Institution by Mr. Samuel Hubbard; *Theodore Gill.*—282, Synopsis of the species of Lophobranchiate Fishes of Western North America; *Theodore Gill.*—284, Descriptions of new genera, subgenera and species of Tertiary and Recent shells; *T. A. Conrad.*—291, Revision of the Gulls of North America: based upon specimens in the Museum of the Smithsonian Institution; *Elliott Coues.*—312, Catalogue of Birds collected by the United States North Pacific Surveying and Exploring Expedition, in command of Capt. John Rodgers, United States Navy, with notes and descriptions of new species; *John Cassin.*